4.0 IDENTIFICATION OF SOURCES

The lower Willamette River and its adjacent upland areas have been used for industrial, commercial, and shipping operations for over a century. During this time, contaminants associated with those practices were released from various sources through migration pathways to the lower Willamette River, which may pose risk to receptors. Many environmental investigations by private entities and state and federal agencies have been conducted, both in the lower Willamette River and on adjacent upland properties, to further characterize the nature and extent of contamination in the river, as well as to identify potential sources of contaminants that could continue to enter the river.

The primary focus of this section is the discussion, by pathway, of the historical and current sources that contributed to in-river contamination within the Study Area. Section 4.1 discusses the potential migration pathways of sources to the lower Willamette River. The process used in identifying sources and pathways within the Study Area is described in Section 4.2. Historical sources of contamination are presented in Section 4.3, and current sources of contamination, including ongoing secondary releases and controls, and DEQ's role in identifying, evaluating and controlling current ongoing sources, are presented in Section 4.4. Potential sources outside the Study Area from upriver reaches of the lower Willamette River~~,~~ and above Willamette Falls are identified in Section 4.5. The relationships between the historical and current sources of contamination discussed in this section and the contaminant distribution in abiotic (e.g., sediments) and biotic media in the Study Area are addressed in Section 10 of this report.

Although this section and its associated tables identify many specific sources of contamination, neither this section nor this RI report generally is intended ~~by the LWG or EPA~~ as an exhaustive list of particular facilities that are current or historical sources of contamination. Identification and evaluation of potential sources is still ongoing by DEQ, and USEPA is continuing its potentially responsible party search. All historical sources may never be known, and current sources likely will continue to be discovered into the future. However, sufficient information about the most likely significant historical and current sources is available for the development of a cleanup plan for the Study Area.

4.1 POTENTIAL MIGRATION PATHWAYS

Contaminants released to media such as air, soil, ground water, surface water, or impervious surfaces may migrate to the lower Willamette River via the following pathways[1]: direct discharge, overland transport, groundwater, riverbank erosion, atmospheric deposition, overwater activities, and upstream watershed. This section

[1] This section addresses external contaminant sources and migration pathways to Study Area sediments. Internal processes, such as bedded sediment resuspension and erosion, are important internal contaminant fate and transport mechanisms and these are discussed in RI Sections 6 and 10.

briefly highlights these potential pathways to the river. In-depth information on specific sources and migration pathways is provided in Sections 4.2 through 4.5.

4.1.1 Direct Discharge

Direct discharge of contamination occurs through conveyance systems, which include municipal or other publicly owned drainage systems, privately owned and managed drainage systems, and sanitary/combined sewer systems. Today, many of these discharges are permitted under ~~the National Pollutant Discharge Elimination System (~~NPDES~~)~~ authorized by the ~~Clean Water Act (~~CWA~~).~~. Permitted discharges under the NPDES program include industrial wastes, stormwater runoff, and ~~combined sewer overflows (~~CSOs~~)~~.[2] ~~.~~

Based on a survey conducted by the City of Portland in 2002, approximately 300 individual outfalls that discharge into the Portland Harbor Study Area have been identified. These individual outfalls are defined here as locations of discharge of stormwater, combined sanitary sewage and stormwater, and/or industrial wastewaters transported via a collection system, although most of the latter two are now routed through the sanitary sewer and no longer discharge directly to the waterway.

Historically, waste disposal in upland pits, lagoons, or lakes also directly discharged to the river through pipes, ditches, and creeks. In addition to direct discharge, contaminated soil, stormwater, and groundwater from past and current spills and leaks of hazardous substances can infiltrate these conveyance systems and be transported by direct discharge systems. Discharges of treated industrial wastes are sometimes discharged to municipal and non-municipal storm drain systems. The classifications of direct discharges include industrial waste systems, CSOs, and public and private storm drain systems.

4.1.2 Overland Transport

Contaminated surfaces ~~-~~in the upland areas can carry erodible soils and particulates directly to the river via sheet flow of stormwater runoff from a site (i.e., not through a conveyance system). Overland transport was likely to have been more important historically, prior to the development of extensive stormwater conveyance systems within the Study Area. However, specific historical information on overland runoff is lacking for most upland properties in the Study Area.

4.1.3 Groundwater

Groundwater flow in the greater Portland Basin within the Study Area is generally towards the lower Willamette River, although the direction varies locally depending on the nature of subsurface materials, hydrostratigraphy, and proximity to the river. Near

[2] CSO events are untreated discharges of combined stormwater and sanitary sewage from residential, commercial, and industrial sources that overflow from the sewer system into the river during heavy rainfall periods when the amount of stormwater and sewage exceeds the capacity of the collection system.

the river, tidal action can greatly alter groundwater flow directions, rates, and water quality.

Groundwater may be contaminated from waste disposal practices, product storage practices, spills and leaks from pipes, storage tanks, industrial equipment, and process operations. Contaminated groundwater may enter directly into the Portland Harbor Study Area via discharge through sediments or bank seeps, or it may infiltrate into storm drains/pipes, ditches or creeks that discharge to the river. Contaminant migration may occur as ~~non-aqueous phase liquids (~~NAPLs~~)~~ or as dissolved phase transport.

4.1.4 Riverbank Erosion and Leaching

Contaminated riverbank soil, fill, or debris may release contaminants directly to the Portland Harbor Study Area through bank erosion or leaching caused by groundwater and tidal action flux. Unprotected shoreline banks are susceptible to erosion by wind, river flows, wave action, tidal changes, and surface water runoff. Shoreline armoring and vegetation reduce bank erosion. Bank slope is also a factor where steeper banks are more susceptible to erosion.

4.1.5 Atmospheric Deposition

Contaminants are emitted to the air from point, mobile, biogenic and area sources.[3]~~.~~ Point sources include emissions from power plants, refineries, incin~~t~~erators, stationary power sources, emission stacks, liquid and petroleum storage tanks, etc. Today, many point source air releases are permitted under the Clean Air Act. Mobile sources include emissions from motor vehicles and non-road equipment, such as railroads, marine vessels, and recreational off-road equipment. Biogenic sources include emissions from natural sources and area sources that are too small to be treated as point sources (footnote 3). ~~Point~~Area sources include industrial releases from power plants, incinerators, stationary power sources, emission stacks, liquid and petroleum storage tanks, etc.

Contaminants emitted to the air may be transported over long distances, generally in the direction of the area's prevailing winds. They can be deposited from the atmosphere to land and water surfaces through wet deposition (precipitation) or dry deposition (as particles). Air pollutants can be deposited to water bodies through either direct or indirect deposition. Direct deposition occurs when contaminants are deposited onto the surface of a water body. Indirect deposition occurs when contaminants are first deposited on land and then transported to the water body via stormwater runoff.

4.1.6 Overwater Activities

Contaminants from overwater activities (e.g., sandblasting, painting, unloading, maintenance, repair, and operations) that may have dumped, sprayed, spilled, emitted or

[3] http://www.epa.gov/oaqps001/emissns.html

otherwise resulted in releases at or from riverside docks, whar~~ve~~fs, or piers; spills or releases from vessels (e.g., gray, bilge, or ballast water); and fueling station (e.g., barge to uplands) releases have the potential to impact the lower Willamette River.

4.1.7 Upstream Watershed

Upstream sources include or have included sewers, stormwater runoff, and direct discharge of industrial wastes; agricultural runoff; and aerial deposition of global or regional contaminants on the river water surface and drainage areas within the Willamette Valley.

4.2 INFORMATION COLLECTION PROCESS

A goal of the RI ~~R~~report is to identify sources of contamination to the in-water portion of the Site, including those sources identified based on information obtained through investigations conducted under DEQ authority. Sources of contamination are often hazardous substances contained in drums, storage tanks, surface impoundments, waste piles, and landfills. Heavily contaminated media (such as soils and groundwater) may also be considered secondary sources of contamination, especially if the original source (such as a leaking tank) no longer exists or is no longer releasing contaminants. ~~.~~ Finally, as described in Section 4.5, regional sources outside of the Study Area, such as the widespread use of p~~r~~esticides/herbicides, fertilizers, and other chemicals, may also contribute to background conditions both within and outside of the Study Area.

Sources can be either historical or current in origin. Historical sources have released ~~contaminants of interest (~~COIs~~)~~[4] to the river in the past, but no longer have an upland source to control. Current sources are direct and indirect releases of COIs from historical or current activities that are migrating to the river through a migration pathway that needs to be controlled. These sources might include discharges from industries, spills, precipitation runoff, erosion of contaminated soil from stream banks or adjacent land, contaminated groundwater and ~~non-aqueous phase liquid~~NAPL contributions, discharges from storm~~-~~water and combined sewer outfalls, upstream contributions, and air deposition. For the purposes of this RI only, current sources are defined as those that are known to be present after 2004, which is the year that LWG began reviewing upland source information.

In February 2001, ~~Oregon Department of Environmental Quality (~~DEQ~~), United States Environmental Protection Agency (~~, USEPA~~)~~, and other governmental parties signed an ~~Memorandum of Understanding (~~MOU~~)~~ that provided a framework for coordination and cooperation in the management of the Portland Harbor Superfund Site to optimize federal, state, tribal, and trustee expertise and available resources. Under the February 2001 MOU, it was agreed that the DEQ, using state cleanup authority, has lead technical and legal responsibility for the upland contamination and for coordinating

[4] ~~Contaminants of Interest~~COIs are hazardous substances that have been released into the environment and are of interest in the ~~remedial investigation~~RI at this ~~s~~Superfund site.

with the USEPA on upland contamination ~~which~~that may impact the river (e.g., sediment, groundwater, ~~transition zone water~~TZW, and/or surface water). However, there are some instances where USEPA has the lead role for source control at the site. The cleanup of known or potentially contaminated upland sites is tracked in DEQ's ECSI database, which is available online at http://www.deq.state.or.us/lq/ECSI/ecsi.htm. It is important to note that sources of contamination in Portland Harbor may include ECSI and non-ECSI sites.

4.2.1 Site Summaries

Site summaries are the primary resource of information on upland sources for the Portland Harbor RI, and are integral to the ~~conceptual site model (~~CSM~~)~~ for the Study Area. Summaries have been prepared for 86 upland sites that were generally located within 0.5 mile of the lower Willamette River between RM ~~2~~1.9 and 11.8, where DEQ-led investigations confirmed releases occurred. Table 4.2-~~2~~1 presents a list of sites investigated by DEQ and indicates which sites had summaries prepared by the LWG. Map 4.2-1 depicts the locations of the sites being investigated by either DEQ or USEPA within the Study Area~~.~~, and also specifies if site summaries were prepared for these sites.[5] One site, GE-NW 28th, is undergoing cleanup under TSCA and does not have a site summary.

The information from the site summaries indicates that the majority of the sources have released or may be releasing hazardous substances to the Study Area, and if continuing sources are not controlled, they would likely recontaminate or contribute to unacceptable risk at the Site. The information in the site summaries also indicates that detailing the pathways and potential COIs associated with the sources within these boundaries in the site summaries (see Table 4.2-2) would provide an adequate assessment of where the majority of contaminants found in the water and sediment at the site came from. However, where other significant historical or current sources outside of these geographical boundaries (i.e., ~~within~~sources outside 0.5 mile of the river between RM ~~2~~1.9 and 11.8) are known, such sources are discussed in the text of ~~Sections 4.3.4.4 and~~ Section 4.5~~, below,~~ and shown in Table 4.~~5-1~~2-3 and on Maps 4.~~5-1a-~~2-2a–d.[6]

It is important to note that site summaries have not been prepared for all DEQ environmental cleanup sites within the Portland Harbor hydrographic basin or for all historical sites with releases that have contributed contamination to the Study Area. Also, potential sources of contamination may exist that have not been reported or included in the DEQ ~~environmental cleanup site information (~~ECSI~~)~~ database or DEQ's upland site files. The information presented in the site summaries is primarily based on

[5] ECSI sites in Map 4.2-1 are as of February 2011. The locations shown on the map are based on the DEQ GIS data augmented by GIS data provided by the City of Portland. The locations of the sites on the two GIS data files can be different.

[6] Neither this ~~S~~section nor the site summaries present all of the information or evidence that may exist~~s~~ regarding any particular person or entity's potential liability for response costs incurred at this Site.

Commented [A1]: EPA:
This map does not adequately display GNL sites. Remove GNL sites from legend. Title of map is ECSI sites, but more information is presented. ECSI sites are current sites, so is this map only for current sources? There needs to be a discussion about the different designators on the map relate to ECSI sites. The title of this may may need to be revised to more accurately reflect the presented information.

Integral: OK, the title of the map has been changed and GNL sites have been removed.

Commented [A2]: EPA:
DEQ does not regularly update the ECSI database, so it does not present the most current and relevant information on a site.

Integral: OK

publicly available documents; a full list of all sources of information relied upon is provided in each site summary. Information presented in the site summaries ranges widely in the scope, detail of information, and time frames. The accuracy of the information in the site summaries has not been assessed by USEPA, nor has the USEPA conducted any independent work to evaluate or verify the information presented.

Each site summary listed in Table 4.2-~~2~~1 describes general site information (location, physical description); owner history; current and historical site uses; potential sources (overwater activities, recent and historical spills); the nature and extent of contaminants in soil, groundwater, surface water, and sediment; stormwater and wastewater permit information; and a summary of cleanup actions. Site summaries have been updated periodically, primarily from information on file with DEQ.

Site summaries were originally published in 2004~~-~~–2005 (Integral and GSI 2005a,b,c), and a subset of the summaries was updated in 2007 (Integral 2007~~s~~r). The status of the ECSI sites within the Study Area is tabulated in Table 4.2-1. For each site listed in the table, the following information is shown:

- The site name and DEQ ECSI number
- The site status (e.g., ~~remedial investigation~~RI, expanded preliminary assessment, not in DEQ cleanup program)
- The site summary documents prepared (e.g., site summary, site summary addendum, no site summary prepared) and dates of documents. It should be noted that site summaries were not prepared for all ECSI sites, but only for a subset (see Table 4.2-1~~-2~~).

The site summaries are based on a review of information in the associated DEQ ECSI files and other readily available public information, as well as information provided by the upland site's current owner. It is important to note that the development of site summaries and the source information presented here ~~is~~are highly dependent on whether a site is involved in DEQ's cleanup program and the degree of investigation and data generation, as well as the level of detail provided in DEQ's ECSI files. As shown on Table 4.2-1, several sites adjacent to or near the Study Area are not in the cleanup program, and it is likely that many sites, particularly those that are the location of historical facilities that operated outside the boundaries of current properties, are not fully addressed in the site summaries. As a result, this section does not represent a complete inventory of sites and operations that contribute or have contributed to contamination in Portland Harbor. These limitations on source information primarily affect historical sources, and the understanding of current significant sources is adequate for the purposes of developing a cleanup strategy for this ~~s~~Site.

4.2.2 Source Table

The Source Table (Table 4.2-2) summarizes information from both the LWG's site summaries and addenda and DEQ's Milestone Report, which is DEQ's ~~report~~ mechanism of reporting to USEPA on the status of source control at the sites.

In Table 4.2-2[7], a contaminant is listed as a pathway COI if it was detected in sampled media, identified as having been released to site media, identified as a site COI, or documented to have been released directly to the river from site operations. The LWG has not separately screened the results against DEQ's JSCS values or any other screening criteria. Note that the LWG and non-LWG stormwater sampling data (as described in Section 4.4.1.2) were not reviewed or screened for the purposes of this table.

COIs for a pathway in Table 4.2-2 were assigned one of four categories (a–d), as defined below, for both historical (H) and current (C) impacts:

Category a. **Documented evidence of a complete transport pathway**—Data demonstrate that the pathway is complete; DEQ, the responsible party, or both concur that the pathway is complete.

Category b. **Likely a complete pathway**—Data suggest that the pathway is complete, but in the absence of confirming data (e.g., investigations are incomplete, nearshore wells are not yet installed, overwater operations are present and active). DEQ, the responsible party, or both have not concurred that pathway is complete. Although DEQ and responsible party evaluations are considered, LWG's analysis may support a different conclusion.

Category c. **Insufficient data to make determination**—Either a release has been documented but there has been no sampling of the potentially affected media, or a release has been documented but transport pathways have not been investigated, or no sampling has been conducted at the site or for a given pathway. Although DEQ and responsible party evaluations are considered, the LWG may have, for the purposes of the CSM, assumed that the pathway is complete.

Category d. **Not a complete pathway**—Information indicates with reasonable certainty one of the following:

- The relevant media for a given pathway likely are not affected by site-related COIs (e.g., site-related COIs are not detected in groundwater)
- A current or historical complete pathway as defined above likely is not present (e.g., riverbank is not present at a site away from the river, COIs were not detected in downgradient groundwater)

[7] The information in Table 4.2-2 of the RI is a compilation of public information available from site owners and operators and from DEQ, and is based upon information provided through September 2010~~, the date of DEQ's most recent Source Control Milestone Report.~~. In some instances DEQ provided specific language to the LWG. The LWG has not independently verified all information provided by DEQ, and to the extent parties and DEQ disagree with language in this table, those differences will be worked out as part of the DEQ Source Control process.

- The pathway is determined by DEQ to be insignificant in the Table 1 of the Milestone Report (DEQ 2010~~c~~a).

The overall importance and relative contribution of the pathway is not evaluated in Table 4.2-2. DEQ's Milestone Reports (see Section 4.~~6~~4.7) rank sites and pathways in terms of priority for investigation and cleanup, but the ranking is not chemical-specific.

For each potential migration pathway that is known or likely to be complete (categories a and b), Table 4.2-2 also shows whether the site's releases are current (C) or historical (H). The overwater pathway is designated H-a or C-a when a release has been documented in the DEQ Emergency Response Information System (ERIS) database, U.S. Coast Guard (USCG) records, the Port's of Portland's 104(e) responses, or other similar documentation. If no spills have been reported for a facility that had or has active overwater operations, the pathway was modified to H-b or C-b.

For the groundwater pathway, Table 4.2-2 includes a column for the presence of NAPL. A "~~yes~~Y" is shown where the pathway is known or likely to be complete. An ~~"no~~"N" is shown where the pathway is known to be incomplete. A question mark is shown if the presence or absence of NAPL cannot be evaluated because of insufficient data.

To help readers track the assessments tabulated in Table 4.2-2, Table 1 from DEQ's Milestone Report is reproduced here as Appendix B. The DEQ Milestone table, which was considered in the development of Table 4.2-2, provides information on the status of DEQ's source control evaluations, decisions, and measures for ECSI sites within the original Study Area as of 2010. The 2010 DEQ table does not list the new ECSI sites in the expanded Study Area (RM 11–11.8) or recently identified sites within the shared stormwater conveyance basins. For the most up-to-date DEQ source information, DEQ's January 2013 Source Control Milestone Report is available on~~-~~line at http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/jointsource.htm.

An important difference between DEQ's Milestone Report and LWG's Source Table is that the Milestone Report focuses on current and potential sources of pollution to the river, whereas the Source Table considers both current and historical releases when information is readily available. As a result, DEQ may identify a source as "insignificant" in the Milestone Report based on the current condition, while LWG may have characterized the same source as a known or potentially complete pathway because of historical conditions or as insufficient data to support a release determination. Additionally, DEQ's Milestone Report prioritizes pathways (high, medium, low) but does not present COIs. The LWG's Source Table identifies COIs for each pathway, but does not prioritize pathways or releases.

4.3 HISTORICAL SOURCES WITHIN THE STUDY AREA

Historical releases from upland or overwater activities within the Study Area likely contributed to the majority of the observed chemical distribution in sediments within the Study Area. Table 4.2-2 provides an assessment for the upland ECSI sites of whether the predominant impact for each of the pathways was historical or current. All the pathways have a historical release component and many can be attributed entirely to historical operations or releases (e.g., historical discharge of waste to Doane Lake, direct discharge of manufacturing waste to the river, and historical discharge of MGP effluent ponds). This section discusses by pathway the major historical operations that contributed to in-river contamination within the Study Area. Note that in this context, the term "pathway" refers only to the physical transport of a contaminant of interest to the Study Area. It does not include identification of exposure points, receptors, or exposure routes.

4.3.1 Direct Discharge~~–~~—Industrial Wastewater, Stormwater, and CSOs

In the early 1900s, rivers in the United States were generally used as open sewers, which was also true for the Willamette (Carter 2006). The process water from a variety of industries, including slaughterhouses, chemical plants, electroplaters, paper mills, and food processors, was discharged directly into the river. Potential hazardous substances associated with these activities may have included VOCs, SVOCs, PAHs, petroleum hydrocarbons, metals, PCBs, pesticides, and herbicides.

From 1926 to 1929, the U.S. Public Health Service collected samples from seven mid-river locations on the Willamette River. Although the studies focused on bacteria and oxygen levels from domestic waste, the sewage discharges also included municipal, industrial, and commercial waste products and stormwater runoff. Conclusions from the study indicated that although oxygen levels were sufficient to support fish life in all but two months of low water in late summer, the overall water quality probably was "not sufficiently pure" to justify recreational uses at any time (Laurgaard 1929, pers. comm.). By the 1930s, the water pollution was so severe that workers refused to work on riverside construction projects because of the foul odors and the risks to their health. Loggers even went on strike because they did not want to handle the scum accumulated on logs (Blalock 2008).

In response to enacted legislation, municipal conveyance systems included interceptors and associated facilities were installed in the 1950s to reduce the volume of untreated sewage discharging to the Willamette from the City of Portland (see discussion in Section 3.2.3.1.11). The ~~Oregon State Sanitary Authority (~~OSSA (1955) concluded that in spite of the fact that considerably less raw sewage was being discharged ~~in to~~into the river by the City of Portland [than the year before], the degree of pollution in the harbor was "approximately the same" in 1954 in terms of dissolved oxygen (DO) and BOD levels. The OSSA noted, however, that based on weekly measurements from seven stations between Willamette Falls and S.P. and S. Railroad Bridge,[8] the BOD levels at

[8] The reference to the S.P. and S. Railroad Bridge appears to be BNSF Railroad Bridge located at RM 6.9. The 1957 OSSA report says (Page 6), "Stream samples were collected once each week … located above the Willamette Falls and extending 20 miles downstream to the S.P and S. Railroad Bridge." Further, OSSA (1957) references the S.P. and S. Railroad Bridge at river mile 7.0 (Page 2).

Willamette Falls were the highest in the OSSA study and that the DO levels at the S.P. and S. Railroad Bridge were the lowest. This OSSA observation indicates that there were sources with high BOD upstream of Willamette Falls.

A special survey of Portland Harbor disclosed that significant quantities of untreated domestic sewage and industrial wastes were being discharged into the river from at least 20 separate outfall sewers and estimated that oxygen demand from industrial sources was three times greater than that from domestic sewage (OSSA 1957). A 1958 OSSA report estimated that "89 percent of the total oxygen depleting pollution load, prior to treatment, is from industrial sources and only 11 percent from domestic sewage" in the Willamette basin (OSSA 1958).

A 1967 federal report on Willamette River water quality stated that low DO was due in large measure to the discharge of untreated wastes of pulp and paper mills upstream of the City of Portland (DOI 1967). Another federal report summarized the water quality problems in the rivers of the Northwest (Figure 4.3-1) and identified the major sources of pollution as reservoir management procedures, agriculture, and factory wastes (DOI 1968). Stevens & Thompson (1964) estimated that the maximum dry-weather flow of 6.3 million gallons per day was discharging through eight City outfalls and 12 private outfalls. This could have been a combination of sewage, industrial waste, cooling water waste, stream flow, and groundwater.

Valuable insight into the magnitude of historical releases is provided by Glen D. Carter, an aquatic biologist employed between 1956 and 1988 by the OSSA, a forerunner to Oregon's DEQ. By the time he was hired in 1956, "fish kills were common in the river, massive rafts of decaying algae floated downstream, and a thick layer of bacterial slime covered much of the river bottom and shoreline. Rotting vegetation, bacterial slime, and countless dead fish produced highly unpleasant sights and odors. Large deposits of sewage sludge accumulated around sewage outfalls" (Carter 2006). In water quality tests performed during this period, fish often suffocated within minutes after being exposed to the water (Carter 2006).

4.3.1.1 Industrial Wastewater

Historical industries directly discharged a variety of COIs based on site-specific commercial and industrial activities, which are described in Section 3.2.3.1.~~.~~ The industrial discharge pathway is not included in Table 4.2-2; however, sites with active individual NPDES waste~~-~~water permits discharging directly to the river are identified in Table 4.2-2 by footnote "b" in the pathway status column. Additional information for these sites, including chemical testing requirements and mixing zones, is presented in Table 4.~~4-6~~3-1.

Other industries that lined the banks of the river most likely had direct industrial discharges as well. Until the late 1960~~'~~s and 1970~~'~~s, it was routine practice for chemical plants to dump waste tars and sludges along or directly into the river. Chemical plants, petroleum terminals, lumber and steel mills, and various other

Commented [A3]: EPA:
Table 4.2-2 does not include this pathway for direct discharge. It needs to be added to the table.

Integral: EPA agreed that adding a direct discharge pathway to Table 4.2-2 was not necessary, but a sentence should be added to the text, which has been done.

Commented [A4]: EPA:
Why not? Need to provide rational here.

Integral: Sites with active individual NPDES permits are identified on Table 4.2-2.

industrial operations within the harbor also directed untreated industrial wastes and wastewaters to the river. ~~Due~~Because of the vast number of various industrial discharges to the river, a large variety of COIs potentially associated with these plants and other industries were released to the river including, but not limited to, herbicides, pesticides, perchlorate, dioxins/furans, mercury and other heavy metals, VOCs, SVOCs, PAHs, TPH (oils, greases, diesels, gasoline), acid/alkaline wastes, phthalates, butyltins, MGP tars, creosote, cyanide, and PCBs.

Examples of industries with known historically complete pathways in the harbor include the former McCormick and Baxter site, where wastewater and non-contact cooling water were discharged directly into the Willamette River between 1945 and 1969 (PTI 1992). The ~~M~~manufactured ~~G~~gas ~~P~~plant effluent ponds along the current Gasco and Siltronic riverbank had drainage or overflow features leading to the river from 1913 to 1956 (HAI 2005a,b). At the former Rhone Poulenc facility, treated and untreated stormwater/wastewater and waste materials were historically discharged to Doane Lake, where they commingled with stormwater and waste material releases from Gould/NL Industries, Schnitzer/Air Liquide, and ESCO (AMEC 2002). Historical aerial photographs indicate that the former Doane Lake periodically discharged to the lower Willamette River through a historical drainage ditch. Historically, surface water collecting in a topographically low area of the Linnton Oil Fire Training Grounds may have periodically discharged to the Willamette River via a series of drainage features.

The ~~Oregon State Sanitary Authority~~OSSA surveyed industrial discharges from private outfalls to Portland Harbor for ~~three~~ 3 years and estimated dry weather flow (i.e., non-stormwater) of 9.9 million gallons per year (mgy) in 1963, 8.92 mgy in 1964, and 0.5 mgy in 1965[9] (OSSA 1966). As discussed in Section 3, once the interceptors were installed in the municipal conveyance systems, many industries routed their industrial wastewater to the sanitary system. A survey of industrial users and wastewater characteristics was conducted in 1974 (City of Portland 1974). Fifty-seven industries were identified in Portland Harbor; 33 of these discharged to the municipal sanitary system, 17 discharged to a CSO system, and 7 did not connect to a municipal system (Table 4.3-~~1~~2). Of the 7 industries not connected to a municipal system, 5 discharged directly to the river (some with pretreatment) and 2 did not.

4.3.1.2 Stormwater

Many of the historical direct discharges were combined flows of stormwater, industrial wastewater, and sanitary wastewater. Stormwater has historically run off to the river through outfalls and as sheet flow. Most of the flows from shoreline properties were discharged through non-municipal outfalls or sheet flow, while flows from non-shoreline properties discharged through municipal, private, or other public agency outfalls or via drainage ditches. The outfalls and drainage basins for the historical shipyards in the area were most likely separate stormwater drainage systems consisting

[9] Survey did not include outfall sewers in the Guild's Lake-Linnton area in 1965.

of multiple outfalls that discharged directly to the Willamette~~-~~. Swan Island also had combined and separated storm and sanitary systems that discharged directly to the river from 1942 to 1953.

Potential contaminants found in stormwater~~,~~ were likely associated with outdoor activities, such as sandblasting, metal plating and surface finishing, painting and sealing, fiberglass construction, leaking hydraulic or pump equipment and transformers, dust suppression activities, maintenance and repair operations, wood treating, leaking storage tanks, spillage or stockpile runoff of raw materials, stockpiling of waste material, and machining and metal working activities. COIs potentially associated with these activities were released to the river including, but not limited to, herbicides, pesticides, ~~-~~dioxins/furans, heavy metals, VOCs, SVOCs, PAHs, TPH (oils, greases, diesels, gasoline), acid/alkaline wastes, phthalates, butyltins, MGP tars, creosote, cyanide, and PCBs.

Based on LWG studies of stormwater (~~citation?~~Integral 2007a; Anchor and Integral 2008a), it is clear such stormwater picks up COIs as it flows across industrial and commercial properties with outdoor process activities, across transportation corridors and residential neighborhoods that have vehicular traffic and parking, and even across open spaces that are subject to atmospheric deposition.

Commented [A5]: **EPA:** Need citation for this study.

Integral: References provided.

In summary, until about the 1930~~'~~s a large majority of the land draining to Portland Harbor was undeveloped~~-~~. Of the developed land, the industrial land use was dominant. As time progressed, more industrial development occurred as wetlands and lakes were filled in the lands adjacent to the river, especially in Mocks Bottom and at the base of the Tualatin Hills. COIs associated with industrial wastewater (described above) could also be found in runoff from these sites, as stormwater comes into contact with industrial operations and ancillary activities. As shown on Maps 3.2-~~14~~3 through 3.2-~~19~~8, residential, commercial, and major transportation land uses comprised a smaller percentage of the overall drainage.

Twenty-five sites have been identified as having a known complete historical migration pathway for stormwater (Table 4.2-2). Another 38 sites have been identified as having likely complete historical pathways for stormwater but lack confirmatory data. Historical stormwater information does not exist for most of the historically and currently present sites discharging to the Portland Harbor.

4.3.1.3 Combined Sewer Overflows and Sanitary Sewer Overflows

As discussed in ~~Chapter~~Section 3, prior to the construction of the interceptor system beginning in the early 1950s, 19 municipal and numerous non-municipal sewers discharged sewage (including industrial waste) and stormwater directly to the Willamette River within the Study Area (City of Portland 1936). Once interceptors and pump stations were installed, all the municipal outfalls were converted to storm-only outfalls or to CSO outfalls, which reduced the frequency of the discharge to the river. Many of the industrial areas draining to the municipal system were separated when interceptors were constructed so industrial waste that had previously discharged to the municipal system was connected directly to the interceptors (i.e., could not overflow to the river). In some cases, dry weather flow (industrial or sanitary waste) continued to discharge to the river from municipal outfalls after the interceptors were constructed until the City implemented additional programs to assure that diversion structure performance was maximized, properties had appropriately connected their pipes to the municipal system, and connections were rerouted (see Section 3.2.3.1.11).

Historically, direct measurement of contaminants in CSO discharges focused on DO, TSS, bacteria, and BOD rather than chemicals and hazardous substances. Assumptions about COIs associated with historical discharges from the municipal sewer system (including direct discharges prior to construction of the interceptor system, wet-weather CSO events after construction of the interceptor system, and dry weather overflows through the CSO outfalls) can be made based on the types of industries and activities (e.g., transportation corridors, parking) that discharged to the system and whether those industries and activities discharged to the combined system at a location that could overflow a diversion structure, as well as from pretreatment records.

As summarized in Section 3.2.3.1.11, most of the municipal CSO outfalls in the Linnton, St. Johns, and Albina (across from downtown) areas served primarily residential customers, with some commercial land use; COIs in those discharges would be similar to those for stormwater and domestic and commercial sewage. The other municipal CSOs present in the harbor were located in the downtown and north downtown areas, which included industrial, commercial, and residential land uses. COIs associated with industries in CSO basins are dependent on the type of industry discharging to the combined system.

Detailed information on specific industries discharging industrial wastewater to the CSO sewer system prior to the 1980s is limited. However, some historical documents provide information about the types of industries discharging to the system during this time. The City of Portland Waste Discharge Permit application to OSSA identified all industries with a significant waste load; 11 industries were located in Portland Harbor. Seven of these industries did not connect to municipal treatment facilities (i.e., not connected to interceptor) and two industries were connected to a separated sanitary system (City of Portland 1967b). Industrial wastewater from the remaining two industries (an industrial laundry and a flour mill) discharged to the municipal combined system, which could reach the river during CSO events. No toxic wastes were reported for these industries (typically during this time only pH, BOD, and suspended solids were reported).

A 1974 Survey of Industrial Users (City of Portland 1974) indicated that facilities were discharging wastewater to the CSO system. The industry types are associated with metals, transportation, laundries, food, rubber, and bag manufacturing, and a flour mill.

Since the majority of CSO discharge consists of stormwater, COIs in overflows could also be associated with contaminants exposed to stormwater. Based on the 1967 and 1974 industrial surveys (City of Portland 1967b, 1974), COIs associated with these industrial wastewaters and/or stormwater within CSO basins may have included metals (iron/steel manufacturing, electroplaters), solvents (various manufacturing industries), PAHs (combustion emissions, road tar, treated wood), and PCBs (transformers, paints, rubber, and plasticizers after 1930).

CSO discharges also include a component of domestic sewage. The constituents in domestic sewage are primarily fecal bacteria and nutrients (which can decrease ~~dissolved oxygen~~DO). Studies of mixed domestic sewage and industrial discharges from other cities have also found low concentrations of contaminants including PAHs, polybrominated diphenyl ethers (PBDEs~~,~~), phthalates, and selected VOCs (~~Palmquist and Hanæus 2005; Rowsell et al. 2010;~~ Gasperi et al. 2008; Pham and Proulx 1997; North 2004; Song et al. 2006; ~~Rule et al. 2006;~~ Wilkie et al. 1996). Although no data are available for Portland Harbor, domestic sewage that may occasionally enter the Study Area through CSOs may contain trace amounts of contaminants from consumer products and other compounds reflecting the ubiquitous presence of some industrial chemicals at low concentrations in urban environments.

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4.3.1.4 Direct Discharge Regulatory History

In the mid-20th century, cities and industries began efforts to improve the quality of wastewater discharged to the Willamette. Flood control reservoirs created by the federal government increased summer flow in the river, which contributed to the dilution of wastes. The State of Oregon and the City of Portland regulated wastewater discharges before the enactment of the ~~Clean Water Act (~~CWA~~)~~ in 1972, but there was minimal regulation of stormwater discharges before the passage of CWA amendments in 1987. State and municipal regulatory programs relevant to wastewater (sewage and industrial) and stormwater discharges are discussed below.

4.3.1.4.1 State of Oregon Wastewater Permits

At the state level, the Water Purification and Prevention of Pollution Law,[10] one of the first comprehensive state water pollution laws in the country,[11] was passed in 1938. The following year saw the creation of the ~~Oregon State Sanitary Authority (OSSA),~~OSSA, which began implementing wastewater treatment requirements. In 1967, the state legislature required a permit for sewage and wastewater discharges from any sewer system and imposed liability for pollution-related injury to fish and wildlife or their habitat.[12] In 1967, the OSSA issued water quality standards for the Willamette River. For the area including Portland Harbor, the water quality standard required that

[10] Oregon Laws 1939, c. 3.
[11] Oregon Dept. of Environmental Quality, Administrative Overview, 2 (Mar. 2003), *available at* http://arcweb.sos.state.or.us/recmgmt/sched/special/state/overview/19970007deqadov.pdf (last visited May 6, 2009).
[12] Oregon Laws 1967, c. 426.

the daily average DO concentration could not be less than 5 mg/L. The standards included “not to exceed” concentrations for several metals and total dissolved solids, the latter of which could not exceed 100 mg/L (OSSA 1967~~a~~b). Also in 1967, OSSA issued an Implementation and Enforcement Plan to detail the facilities or actions needed to achieve compliance with the standards, a time schedule for such compliance, the controls and surveillance to be used in measuring compliance, and the measures to be taken for ensuring compliance. Part of this plan included identification of major municipal and industrial waste sources; in the Portland Harbor area, this included the City of Portland and the industries identified in Table 4.3-~~2~~3 (OSSA 1967~~a~~b).

The OSSA meeting minutes from 1967 and 1968 indicate that a number of these industries were approved for discharge permits from OSSA. The minutes also identified other industrial facilities to be permitted, including Northwest Sand & Gravel, Willamette Western-River St, Ash Grove Lime and Portland Cement, Centennial Mills, Phillips Petroleum, Richmond Tank Car Manufacturing, Pacific Building Materials (OSSA 1967~~b~~c), Oregon Steel Mills (aka Gilmore Steel) (OSSA 1968~~b~~a), Shipper’s Car Line (OSSA 1968~~c~~b), and Oregon Steel Mills at Rivergate (OSSA 1968~~d~~c). In many cases, the permits were issued on a temporary basis in order to collect additional information to develop permit conditions. When the northwest interceptor was completed in the early 1970s, many of these industries in the northwest area connected to the municipal sanitary interceptor, thus preventing these wastes from entering the river except during an SSO event.

The focus of OSSA was predominantly on pollutants for which water quality standards were established, and no information was found cataloging toxic waste materials in historical discharges. Beginning in 1973, industrial and municipal point source dischargers were required under the ~~Clean Water Act~~CWA to obtain ~~National Pollutant Discharge Elimination System (~~NPDES~~)~~ permits for their wastewater and process water discharges. The federal program was delegated to the State of Oregon in ~~date?~~1973. NPDES permits for wastewater and process water are administered by ~~the Oregon Department of Environmental Quality~~DEQ and set effluent limits, monitoring requirements, and other conditions on the discharges. The requirements can be individual, written for a specific facility, or general, applicable to a group of dischargers having similar characteristics.[13] In some cases, stormwater discharges were also included in these individual NPDES permits.

Since ~~(date?),~~1973, the City of Portland ~~combined sewage overflows~~CSOs that discharge to the Willamette River are regulated under an NPDES permit for the CBWTP, which discharges effluent to the Columbia River.

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[13] http://www.epa.gov/npdes/pubs/101pape.pdf.

4.3.1.4.2 City of Portland Industrial Pretreatment Municipal Permits

At the municipal level, the City of Portland regulated industrial wastewater discharges (which could be either continuous or batch discharges) to the City sanitary and combined systems. The City of Portland's specific authority to prohibit discharges of contaminants to the Willamette River within the City of Portland dates to at least 1942.[14] Revisions to the City Code in 1960 prohibited discharges to the public sewer of specific materials, including gasoline and other petroleum products, solvents, acids, and toxic wastes, and required pretreatment of industrial wastes prior to discharge to the public sewer.[15] Restrictions on the discharge of commercial and industrial wastes were added and preliminary treatment was required for a number of contaminants before discharging wastewater to the municipal system.[16] Between 1969 and 2006, the City Code was amended ~~ten~~10 more times to further limit discharges of untreated wastes to the City's storm and sanitary sewer systems.

Starting in the 1960s, the City began working with industries connected to the City system to reduce discharges of wastes to the City of Portland's sanitary or combined sewer, such as requiring the installation of pretreatment systems for industrial wastes (City of Portland 1966a). Wastewater monitoring typically included pH, BOD, and suspended solids; other monitoring parameters (heavy metals, phenols, cyanide) were added, depending on wastes identified by the industry (City of Portland 1980). Regulation was through wastewater permits or administrative enforcement actions (City of Portland 1980; SAIC 1987).

In order to identify industries that needed pretreatment controls, the City compiled a list of businesses and Standard Industrial Classifications ~~(SIC)~~ in Portland whose discharges could have an effect on the treatment plant or receiving waters. As of 1972, the City had identified 300 industries that had discharges potentially damaging to the treatment system (code compliance violator) and 55 high strength (BOD or TSS) dischargers. Evaluation of the discharges was prioritized to address the most critical industry groups first, such as the metal plating industry (City of Portland 1980).

Early pretreatment efforts had less impact in the Study Area, since there were few CSO areas that contained industrial properties and their discharges (see Section 3.2.3.1.11), but they likely reduced overall discharges to the Willamette River. As discussed in Sections 4.3.1.1 and 4.3.1.3, only 2 of the 11 industries identified in 1967 and 17 of the 57 industries identified in 1974 were connected to a CSO system. All identified industries discharged at or upstream of RM 9.8 (wastewater from Centennial Mills would actually overflow upstream of the Study Area). All but 1 of the industries were located on the west side of the river (see Table 4.3-~~1~~2).

[14] City of Portland Charter, § 9-604(22) (1942)
[15] City of Portland Ordinance No. 111595 (1960).
[16] *Id.*

USEPA first issued regulations for the National Pretreatment Program in 1978 and revised these regulations in 1981 (USEPA 1983). The federal pretreatment program required publicly owned treatment works with greater than 5 million gallons per day design flow to establish a pretreatment program as a condition of their NPDES permits.

The City submitted a report to DEQ in 1980 outlining its pretreatment program and identifying modifications needed to comply with the new federal requirements (City of Portland 1980). The City of Portland's NPDES pretreatment program for the CBWTP was approved in March 1983 (SAIC 1987). In the early 1980s, 260 industrial users were discharging to the City's interceptor system throughout the city and from six outlying areas (SAIC 1987). Based on the 1985 Industrial User Survey, there were 62 industrial users identified in Portland Harbor; 41 of these discharged to a municipal sanitary system, 15 discharged to a municipal CSO system, and 6 did not discharge industrial waste to any City system (City of Portland 1986). The City used these industrial surveys to identify potential facilities subject to federal categorical and prohibited discharge standards or to local standards to comply with the new federal pretreatment requirements.

4.3.1.4.3 Stormwater Permits

Stormwater discharges had very little control and/or monitoring before the passage of the CWA amendments of 1987, which specifically addressed stormwater discharges, and USEPA stormwater rules became effective in 1990.[17] These rules ultimately required stormwater permits for industrial dischargers, discharges from construction activities, and discharges from municipal separate storm sewer systems serving urban areas.[18]

Since the State of Oregon has been delegated federal authority to administer the federal stormwater program under the CWA, DEQ administers several types of NPDES stormwater permits in Oregon, covering municipal, industrial, and construction-related operations. Municipal entities, such as the City of Portland and the Port of Portland, that discharge in the Study Area are regulated by ~~Municipal Separate Storm Sewer~~ ~~(~~MS4~~)~~ NDPES stormwater permits; industrial dischargers that discharge into the Study Area are regulated by 1200-Z NPDES stormwater or individual NPDES permits; and discharges from construction activities are regulated under 1200-C or 1200-CA NPDES stormwater permits. Current municipal and industrial permittees that discharge in the Study Area are listed in Table~~-~~ 4.3-~~3~~4 and shown on Map 4.3-1.[19]

Point source stormwater discharges from certain types of businesses and industries—such as manufacturers, hazardous waste treatment facilities, and publicly owned

[17] 55 Federal Register 47,990 (November 16, 1990).
[18] *Id.*
[19] ECSI sites shown in Map 4.3-1 are as of June 2011. The locations shown on the map are based on the DEQ GIS data augmented by GIS data provided by the City of Portland. The locations of the sites on the two GIS data files can be different.

treatment works[20]—are regulated by NPDES Industrial General Stormwater Permits, which were first issued by DEQ in 1991. Industrial activities that are subject to permitting requirements are determined by Standard Industrial Classification or Industrial Activity codes listed in the federal regulations 40 CFR 122.26(b)(14) and (15). Since the National Multisector General Permit has only identified 29 industrial sectors to be regulated for stormwater, many properties are ~~unregulated with respect to stormwater discharges because they are~~ not required to have an NPDES permit because they do not fall within the regulated industrial activities and are therefore unregulated with respect to stormwater discharges.

Activities regulated under the industrial stormwater permits include:[21]

- Heavy manufacturing (such as paper mill, chemical plants, petroleum refineries, and steel mills)
- Light manufacturing (such as food processing, printing and publishing, electronic manufacturing)
- Coal and mineral mining and oil and gas exploration and processing
- Hazardous waste treatment storage and disposal facilities
- Landfills, land application sites, and open dumps with industrial wastes
- Metals scrap yards, salvage yards, automobile junkyards, and battery reclaimers
- Steam electric power generating plants
- Transportation facilities that have vehicle maintenance, equipment cleaning, or airport de-icing operations
- Treatment works treating domestic sewage with a design flow of 1 million gallons a day or more
- Other facilities subject to federal stormwater effluent discharge standards ~~in the~~under 40 CFR Parts 405-47.

However, some categories (e.g., mineral extraction industry, transportation, and light industry) have special conditions or exceptions that may exclude a facility from the stormwater permitting requirements. Also, stormwater discharges associated with the wholesale, retail, commercial, or service industries are exempt.

The NPDES stormwater program requires a regulated facility to develop a stormwater pollution control plan that identifies pollutant sources and specifies best management practices (BMPs) to minimize impacts on stormwater quality.

[20] For the full list, see USEPA, Categories of Industrial Activity that Require Permit Coverage, http://cfpub.epa.gov/npdes/stormwater/swcats.cfm (accessed May 5, 2009).
[21] http://cfpub.epa.gov/npdes/stormwater/swcats.cfm

In 1994, the City of Portland entered into a memorandum of agreement (MOA) with DEQ to administer industrial stormwater NPDES permits for discharges to the City's MS4. In 1999, the MOA was revised to cover all industrial NPDES stormwater permits in the City's urban services boundary. The City administers the general 1200-Z permits in the Portland Harbor and inspects sites for compliance; DEQ maintains responsibility for enforcing permit conditions.

DEQ's 1200-C and 1200-CA stormwater permits cover construction activities. NPDES 1200-C Stormwater Discharge Permits, first issued by DEQ in 1991, are required for any construction activities that disturb ~~five~~5 or more acres of land to control erosion and reduce sedimentation in waterways. In 2002, the threshold for construction activities was lowered to include projects that disturb ~~one~~1 or more acres of land.

While the development and implementation of stormwater regulations have resulted in significant reductions in uncontrolled releases to the river, both permitted exceedances and unpermitted releases continue to occur.

4.3.2 Overland Transport

Contaminated surface soils exposed in the upland areas can be carried directly to the river in uncontrolled runoff (e.g., non-channelized or non-piped stormwater runoff). Overland transport was likely to have been more important historically, prior to the development of extensive stormwater conveyance systems within the Study Area. However, specific historical information on overland runoff is lacking for most sites. At former shipbuilding facilities with shipways, the upland site drainage patterns were conducive to the migration of contaminants to the river through stormwater sheet runoff (USEPA 1997a).

Overland transport has been identified in Table 4.2-2 as a complete historical pathway for only three ECSI sites within the Study Area: Gasco, Gunderson, and McCormick and Baxter. The historical overland transport pathway has been identified as likely complete at eight other ECSI sites, but confirmatory data are lacking. As with other historical pathways, very little information is available on the details of operations and COIs, and it is more than likely that there were many more sites contributing COIs to this pathway.

4.3.3 Groundwater

Contaminated groundwater may have entered the river historically via discharge through sediments or bank seeps, or it may have infiltrated into storm drains/pipes, ditches, or creeks that discharge to the river. Contaminant migration may have occurred as NAPLs or as chemicals dissolved in the groundwater itself. Though insufficient data are available to evaluate the historical groundwater pathway at most sites reviewed (Table 4.2-2), significant contaminant migration via the historical groundwater pathway has been identified at a small number of upland ECSI sites within the Study Area. At a limited subset of these sites, the upland groundwater may have loaded upland chemicals to the local transition zone, including sediment and pore water. Because several of these sites are considered current sources of contamination as well, they are discussed in detail in Section 4.4.3. At McCormick and Baxter—the historical pathway was complete, but recent groundwater source control efforts from the comprehensive remedial action at this site have been effective at reducing or eliminating the impacts from this pathway.

4.3.4 Riverbank Erosion

As discussed in Section 3.2.2, the majority of the shoreline sites in Portland Harbor have been filled to extend the land surface into the former river channel. In many areas, the fill approaches 30 ft in thickness. In some locations, materials used for fill extend to the riverbank and may ~~or~~ not be protected from river flows and erosion (see Maps~~-~~ 3.~~2-20a~~1-14a–f). The most common fill materials are hydraulically placed sands and silts dredged from the river, although upland investigations have shown waste materials (e.g., concrete, slag, asphalt shingles, sandblast grit, etc.), quarry materials, and clean soil have also been used as fill. Though there are no records of the quality of dredge material used for fill, it is likely that the fill materials included contaminated dredge spoils at some locations.

Bank soils can be eroded directly into the river (especially from unarmored or unprotected banks) by in-water forces due to fluctuations in river levels, currents, floods, boat wakes, and propeller wash from ship activities. Over the past 150 years, the Willamette River has experienced numerous floods. Most recently during the floods of 1964 and 1996, the river fully occupied its historical floodplain in the lower, narrower portion of the river and much of the mid-river portion as well.

In some locations, low-lying contaminated riverbank soils can be prone to erosion, and potentially contribute to sediment contamination in the river. These low-lying bank areas are particularly prone to erosion during periodic flooding events. The occurrence and relative importance of riverbank contamination is not well characterized for all parts of the Study Area, but is a focus of DEQ's source control investigations.

Because of the limited historical data, riverbank erosion has been identified on Table~~-~~ 4.2-2 as a "known" historical pathway for six ECSI properties within the Study Area: Arkema; Gasco; McCormick and Baxter; Port of Portland Terminal 4 Slips 1 and 3; and ~~Evraz Oregon Steel Mills (~~EOSM~~)~~.[22] This identification is based upon the detection of elevated concentrations of COIs in riverbank soils. Ten additional ECSI sites are likely complete historical pathways for riverbank erosion but lack confirmatory data, and 38 sites lack enough information as to determine the completeness of the pathway.

[22] See also Map 4.~~6-1a~~4-4a.

4.3.5 Atmospheric Deposition

Air pollution comes from both natural and manmade sources and can be in the form of either gasses or particulates. Historical air pollution sources were much greater prior to the creation of the Oregon Air Pollution Control Agency in 1952 and the Clean Air Act of 1970, which required air pollution controls. A partial list of principal historical anthropogenic pollution sources in Portland Harbor include chemical plants, manufactured gas plants, petroleum and natural gas storage, flour mills, asphalt plants, incinerators, metal smelters, boiler furnaces, ship repair/refurbishing, recycling activities, and mobile sources such as motor vehicles, marine vessels, locomotives, and aircraft.

Regional sources included automotive emissions, lead smelters, pesticide application, combustion sources, volcanoes, and energy generation. Chemicals commonly acknowledged to play an atmospheric source role in urban river settings within the broader geographic region of the Pacific Northwest include PCBs, dioxins/furans, PAHs, and mercury. For example, extensive examination of the role of atmospheric deposition of such chemicals has been performed for the Columbia River Basin (USEPA 2009a). From the study, it has been found that:

- Atmospheric deposition from sources inside and outside the region is thought to be a major pathway for mercury~~;~~
- Incineration and atmospheric deposition bring PCBs from distant sources which are then contributed to the basin.

Global atmospheric transport and subsequent deposition has also been documented as a significant transport mechanism for dioxins and furans (Commoner et al. 2000; Augusto et al. 2004).

Table 4.2-2 does not address atmospheric deposition, although several of these facilities likely were historical sources of air pollution. Information on the importance of this pathway is provided in Sections 6 and 10 of this report.

4.3.6 Overwater Releases

Historically, overwater releases were common occurrences for industries on the banks of the Willamette that relied on maritime shipping to get commodities to and from market. Overwater releases are important contributors to in-water contamination at sites that have long histories of overwater operations and product transfers.

Historical~~,~~ overwater releases were likely to have been associated with refueling, loading/offloading of hazardous materials, activities conducted on docks or piers, and overwater ship maintenance. It was common practice before controls were put in place for ship repairers and repair facilities to allow sand blast grit to go directly from docks and dry dock to the river by paint scraping and abrasives blasting directly overwater and by lowering the dry dock and allowing any materials on the surface of the dry dock to wash into the Willamette River.

The overwater release pathway is complete historically for approximately 29 ECSI facilities and is a likely complete pathway at 14 ECSI facilities within the Study Area. ~~As discussed in Section 4.2, a~~Any spills that occurred prior to January 1, 2004, are considered historical. (Spills that occurred after January 1, 2004, are considered current overwater releases and are discussed in Section 4.4.6.) Of these facilities, some of the largest spills of commodities have occurred at bulk fuel facilities (e.g., ARCO, Kinder Morgan Linnton, Willbridge Terminal), commodity shipping facilities (Goldendale Aluminum, Port of Portland Terminal 4), and ship repair facilities (Schnitzer Steel, Cascade General). Other types of spills include aviation fuel, diesel, Bunker C fuel, gasoline, asphalt, lube oil, hydraulic fluid, crude oil, sandblast grit, scrap~~p~~ing wastes, ballast/bilge water, waste oil, and generator fuel.

Table 4.~~2~~ 3-5 lists documented overwater spills for the ECSI sites within the Study Area based on information from DEQ, the USCG, the Port of Portland, and the National Response Center's ~~(NRC)~~ centralized federal database of oil and chemical spills. Table~~-~~ 4.3-~~4~~6 provides information on additional spills in the Study Area, primarily from vessels, that are not associated with known ECSI sites. Overwater releases were generally not regulated prior to the 1980s; therefore, few records are available for inclusion in the tables.

4.4 CURRENT SOURCES WITHIN THE STUDY AREA

Current sources of COIs to the Study Area are discussed in this section. Some of the most significant current sources are the result of historical industrial operations, waste disposal, spills and leaks that contaminated soil, groundwater, or the banks that continue to be released to the Site. Identifying current sources is critical to understanding remedy effectiveness and recontamination potential for the FS and subsequent cleanup. Information presented in the following subsections varies in detail because of differences in the level of understanding and quantitative investigation of the various pathways associated with the upland sites. Information on the relative contributions from overland runoff, riverbank erosion, atmospheric deposition, and overwater releases is limited, and these potential sources are described in general terms.

4.4.1 Direct Discharge~~ – ~~—Industrial Wastewater, Stormwater, and CSOs~~,~~

Pollutants from commercial, industrial, private, or municipal outfalls are being discharged directly to the Study Area. Some discharges are permitted under the CWA NPDES program, while some non-municipal outfalls and pipes are not permitted or the status is unknown. Discharges from outfalls include industrial wastewaters, stormwater runoff, and CSOs. The City has tracked SSOs (emergency overflows from sewage pump stations) since 1996: there are no records of SSO events in Portland Harbor.

As presented in the Section 3.2.3.~~1~~11 discussion of conveyance systems, stormwater and wastewater enter surface waters via pipes, culverts, ditches, catch basins, and other types of channels. In the Study Area, both stormwater and treated wastewater generally enter the river via constructed conveyance systems and outfalls. All wastewater discharges and stormwater discharges from certain types of facilities require a NPDES permit.

Oregon DEQ issues two types of NPDES permits: general and individual. General permits are issued to dischargers with similar operations and type of waste. Individual permits are issued to facilities whose processes or wastewater/stormwater flows merit unique monitoring requirements. There are 14 individual industrial wastewater permit holders amongst 13 facilities (Columbia River Sand and Gravel – Linnton Facility holds two permits) discharging to the Study Area. There are no municipal wastewater treatment plant discharges in the Study Area. However, the ~~2002~~2011 NPDES permit for the CBWTP permitted the City of Portland to discharge CSO and pump station overflows (SSOs) into the Study Area from designated outfalls. The ~~2002~~2011 permit is currently in effect. The Port of Portland, ODOT, Multnomah County, and the City of Portland discharge stormwater under MS4 permits, which include discharges to the Study Area.

As of February 2011, there were approximately 114 general NPDES stormwater and 14 general NPDES wastewater permitted discharges to the Study Area, as listed in Table 4.3-~~3~~4. Map 4.3-1 shows permitted facilities and the type of permit. Note that multiple permits may be associated with a single outfall. The number of NPDES-permitted discharges by type of permit is shown in Table ~~X~~4.4-1.

~~**NPDES Permit Type**~~	~~**Number of Permits (as of 2/2011)**~~
~~General Permits for cooling water/heat pumps **(GEN01)**~~	~~8~~
~~General Permits for boiler blowdown **(GEN05)**~~	~~2~~
~~General Permits for treatment of groundwater **(GEN15A)**~~	~~4~~
~~General Permits for stormwater **(GEN12A,C,Z)**~~	~~86~~
~~Individual Permits for facilities not elsewhere classified that dispose of primary smelting/refining of metals not elsewhere classified **(NPDES-IW-B08)**~~	~~1~~
~~Individual Permits for facilities not elsewhere classified that dispose of process wastewater (includes remediated groundwater) **(NPDES-IW-B14)**~~	~~1~~
~~Individual Permits for facilities not elsewhere classified that dispose of process wastewater **(NPDES-IW-B15)**~~	~~6~~
~~Individual Permits for facilities not elsewhere classified that dispose of non-process wastewater **(NPDES-IW-B16)**~~	~~4~~
~~Municipal Separate Storm Sewer System Discharge Permit **(NPDES-DOM-MS4-1)** including CBWTP~~	~~1~~

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~~NPDES Permit Type~~	~~Number of Permits (as of 2/2011)~~
~~Individual Permits for facilities that dispose of sewage (50 MGD or more) **(NPDES-DOM-A1)**~~	~~1~~

Individual permits are specifically tailored to an individual facility's unique discharge and contain more than just unique monitoring requirements. They also contain specific limitations or conditions for that facility. Individual permit limits may be based on either effluent concentrations or total loadings, incorporating factors such as mixing zones or available technologies. Thirteen facilities within the Study Area have individual permits and are denoted with a footnote in Table 4.2-2. Discharge monitoring requirements, effluent limits, and information on mixing zones are provided for these 14 individual permits in Table 4.~~4-6~~3-1.

The vast majority of permitted discharges to the Study Area (by number of permits) are for industrial stormwater discharges under general permits (NPDES GEN12Z). Instead of flow or chemical limits, these permits specify benchmark concentrations to help permittees evaluate the effectiveness of their stormwater management practices. Table~~-~~ 4.4-~~7~~2 lists the permit discharge requirements for each type of general permit. Monitoring parameters for NPDES GEN12Z are limited to pH, oil and grease, TSS, copper, lead, zinc, and sometimes E. coli. The monitoring data generated under these permits provide some data regarding metals and TSS but are otherwise are of limited value in identifying sources. General stormwater permits are limited to a handful of parameters, most of which are not related to Portland Harbor ~~COCs~~COIs. Individual wastewater permits are specific to the individual process at the facility. Therefore, the data collected from general stormwater and individual wastewater permit facilities are not a good gauge of Study Area contaminants.

Other tools that have been used to control active discharges include industrial process changes, pollution prevention practices, and technology-based effluent controls. These tools, in addition to the development and implementation of stormwater regulations, have resulted in significant reductions in uncontrolled releases to the river. However, not all industrial operations and many other operations near the Study Area (wholesale, retail, commercial, or service industries) are not currently regulated.

4.4.1.1 Industrial Wastewater

Discharges of industrial wastewater to the Study Area are required to have a permit. The facilities with permits discharging to the Study Area are authorized to discharge process water, oil/water separator discharge, petroleum hydrocarbon cleanup wastewater (tank cleanup and groundwater treatement), vehicle and equipment washwater, boiler blowdown, filter backwash, cooling water, heat pump wastewater, and rinse water of various types. Permitted wastewater discharges are generally required to be treated before discharge.

Information on wastewater discharges, including a list of the hazardous substances being discharged to the river, the concentrations and loads per day, information on mixing zones, and the COIs that may pose risk to the river, is included in Section 6 of this report.

4.4.1.2 Stormwater

The following sections provide a brief description of the stormwater basins, the types of stormwater discharges, potential sources, currently available data.

Maps 4.4-1a–d present the following information:

- Municipal and non-municipal stormwater and CSO and SSO outfalls
- Stormwater conveyance system piping
- Streams discharging to the Study Area.

The maps also contain a characterization of the Study Area showing areas:

- With shared conveyances (e.g., City and Schnitzer-International Slip outfalls)
- With direct discharge (either through outfalls or sheet flow)
- Known to have no stormwater discharge, such as a site where there is specific information that the site/area only has infiltration and no ability to discharge stormwater (e.g., PGE-Harborton, which has a berm around it so no stormwater runoff occurs)
- With uncertain drainage.

4.4.1.2.1 Summary of Stormwater at ECSI Sites

Oregon DEQ began in approximately 2004 to include stormwater evaluations as part of source control evaluations under the DEQ/USEPA JSCS program for Portland Harbor. Of the 114 facilities in the Study Area with permitted stormwater discharges (see Section 4.4.1~~.4~~), most have not yet conducted a stormwater source control evaluation or are recently in the process of conducting one. Of those ECSI sites for which stormwater source control evaluations have been completed, stormwater discharge has been determined to be a complete and current pathway at ~~nine~~9 sites and a likely complete pathway at 24 sites. For a site to have a complete or likely complete stormwater pathway, COIs have been identified in site-reported stormwater data. No screening of stormwater COIs has been performed by the LWG. However, as noted in Section~~-~~ 4.4.1.2.3, JSCS screening values for stormwater were exceeded in every land use sampled for at least some chemicals based on the LWG sampling program discussed below.

4.4.1.2.2 Potential Sources to Shared Conveyances Draining Stormwater from Multiple Properties

Just under half of the stormwater drainage to the Study Area is through shared conveyance systems. The majority of these private, non-municipal outfalls are not monitored nor were they sampled for the RI/FS. To qualitatively evaluate potential COIs from these systems, the LWG evaluated COIs from ECSI sites within the basins, public records, and, where available, from sampling data. Table 4.4-~~1~~3 identifies 39 City outfalls, 8 outfalls for Burgard Industrial Park, 4 owned by ODOT, and 15 unknown multiparty active and inactive outfalls, including multiple properties that discharge to Saltzman Creek. In addition, information on the outfall structure is included (e.g., location, affiliated organization, outfall size, outfall material, outfall status, basin area). Analytes shown in bold font are permitted under the NPDES 1200Z permit (City of Portland 2010). ECSI sites within each basin and sites immediately upstream of the outfall on the main stem of the river are identified in the table.

For each of these sites, COIs were determined either through review of site summaries, public records, or DEQ's ECSI database. Sites for which the stormwater pathway has been independently investigated (e.g., DEQ's site discovery process or JSCS pathway evaluations are being conducted) are identified in Table 4.4-~~1~~3. Sites that have not had stormwater pathway evaluations (which typically include sites where cleanup occurred before the JSCS, inactive sites, and sites in former CSO basins) are shown as Other Potential Sources in Table 4.4-~~1~~3. There was insufficient information on these sites to include them in Table 4.2-2, but they are included in Table 4.4-~~1~~3 to provide a list of potential historical sources.

The non-municipal shared conveyance systems draining to the Study Area basin areas ~~for these systems~~ are typically not defined, so potential sources in these basins are unknown. As described in Section 4.4, Table 4.4-~~1~~3 provides a compilation of known and potential sources but is not an exhaustive list of current or historical sources of contamination. Identification and evaluation of potential sources is still ongoing.

COIs were identified through investigations at or adjacent to sites draining to 21 outfalls and included PCBs, TPH, metals, VOCs, PAHs, phthalates, and DDx[23] at one or more outfalls (see Table 4.4-~~1~~3; DEQ 2009~~a~~b; Anchor 2006~~a~~e, 2008f; Anchor QEA 2009d; GeoDesign 2008, pers. comm.; MWH 2009; City of Portland 2006e, 2009~~a~~b; PES 2008; SES 2008; Evren Northwest 2007; CH2M Hill 2008; Consolidated Metco 2008, pers. comm.).

4.4.1.2.3 Summary of Stormwater Sampling

Stormwater sampling data are presented below from two sources. The LWG sampling program data are used in Section 6 to generate estimated stormwater loads to the Study Area for the purposes of fate and transport modeling and recontamination analysis. The

[23] DDx represents the sum of the 2,4'- and 4,4'- isomers of dichloro-diphenyl-dichloroethane (DDD), dichloro-diphenyl-dichloroethene (DDE), and dichloro-diphenyl-trichloroethane (DDT).

non-LWG stormwater data were provided by DEQ in early 2008 for sites collecting data under the JSCS program and are presented for reference purposes in this section but will not be used in estimating stormwater loads, as directed by USEPA. Stormwater sample locations and analyses are summarized in Section 2.1.4.1.3.~~.3.5~~, with tabular detail for LWG and non-LWG collected stormwater data in Appendix C1.

LWG Sampling Program

Land use classifications for the overall ~~s~~Study ~~a~~Area by drainage basin include parks and open space/vacant; light industrial; heavy industrial; residential/commercial; and major transportation. Maps 4.4-2a–d indicate the distribution of land uses through the Study Area. Further discussion on how various City zoning classifications were grouped into land uses is included in Section 6.1.2.1. Generally, areas adjacent to the river are dominated by industrial land uses. The largest combined areas of Heavy Industrial land use are on the east bank from RM 1 to 5 and on the west bank from RM 7 to 10. From RM 8 to 10 on the east bank of the river is the largest area of Light Industrial land use. Extensive areas of Parks and Open Space land use occur slightly away from the west bank from approximately RM 1 to 10. Similarly, much of the area east and away from the river from RM 5 to 12 is Residential/Commercial land use. Although Major Transportation thoroughfares extend throughout the Study Area, the largest areas tend to be at the upper reaches of the Study Area.

Stormwater composite water and sediment samples were collected from a subset of drainage basins/outfalls within each land use category in the Study Area. These locations were sampled by LWG during two sampling efforts in the spring/summer of 2007 (Round 3A) and the fall/winter of 2007–2008 (Round 3B), Port of Portland (Terminal 4 composite water and sediment trap samples at outfalls 52C and 53), and City of Portland (OF-53 composite water samples). One additional site (GE Decommissioning) was sampled by GE during the same time frame. Results from the GE investigation ~~will also be~~are used in the overall LWG stormwater data set. The stormwater composite water and sediment trap data were collected in accordance with the Round~~-~~ 3A Stormwater FSP and Addendum (Anchor and Integral 2007~~a,~~b,c) and its companion document, the Round 3A Stormwater Sampling Rationale (Anchor and Integral 2007~~c~~d), and analyzed in accordance with the QAPP Addendum 8 (Integral 2007~~r~~m).

Table 4.4-~~2~~4 provides summary statistics for ~~nature and extent indicator chemicals~~ contaminants in~~for~~ stormwater collected by the LWG. Appendix C1, Table C1-1, provides summary statistics for composite water and sediment traps for all stormwater chemicals analyzed during LWG stormwater investigations. Summary statistics for the LWG data include all LWG data, plus Terminal 4 catch basin and stormwater data (including City outfalls that are not part of Terminal 4), and GE Decommissioning stormwater data used for the stormwater loading analysis provided in Section 6 of this report.

Commented [A11]: **Integral:**

Revised because the concept of indicator contaminants has not been introduced yet.

Concentrations of ~~indicator chemicals~~certain contaminants, such as total PCBs, total PAHs, DDx pesticides, non-DDx pesticides, bis(2-ethylhexyl)phthalate (BEHP), hexachlorobenzene, and metals, in the LWG stormwater sampling results were compared by land use. For the vast majority of ~~indicator chemicals~~these contaminants, including composite water and sediment data collected for total PCBs, total PAHs, DDx and non-DDx pesticides, and metals, samples taken from Heavy Industrial land use locations had the greatest concentrations. Exceptions include isolated metals (i.e., lead) in Light Industrial sediment trap data. Analyte concentrations collected from Open Space and Residential land uses were generally lower than other land uses. JSCS values for stormwater were exceeded in every land use sampled for at least some chemicals. The analysis of this data in terms of projected loads (which takes into account acreage of the various land use types) is contained in Section 6 of this report.

Non-LWG Sampling Program

In addition to the LWG stormwater data, at LWG's request, DEQ provided stormwater data in early 2008 for sites that had thus far collected data under the JSCS program. Table 4.4-~~3~~5 provides a summary of the locations, sampling dates, data quality, and parameters analyzed. Table 4.4-~~4~~6 provides summary statistics for ~~nature and extent indicator chemicals~~contaminants ~~for~~in stormwater collected by non-LWG parties. Appendix C1, Table C1-2 provides summary statistics for all stormwater chemicals collected during non-LWG stormwater investigations. Summary statistics for the non-LWG stormwater data are limited to data collected after January 1, 2004, and before early 2008, and are Category 1 data.

In addition, Table 4.2-2 summarizes ECSI sites being investigated by DEQ through its site cleanup program and Table 4.4-~~3~~5 provides specific information regarding the characterization of stormwater in Portland Harbor; not all properties listed on Table 4.4-~~3~~5 are listed on Table 4.2-2.

4.4.1.3 Combined Sewer Overflows

In 1990 the City of Portland modeled approximate annual volumes for historical ~~combined sewer overflows~~CSOs in preparation for development of a facilities plan for its Combined Sewer Overflow Plan. Estimated ~~combined sewer overflow~~CSO volumes in Portland Harbor are shown in Figure 4.4-1. Based on these modeled volumes, in 1970 approximately 1.6 billion gallons of combined stormwater and wastewater (sanitary sewage and some industrial wastewater) overflowed in the Portland Harbor Study Area. By 1990 the overflow volume had decreased to approximately 925 million gallons annually.

By 2001 the overflow volume was reduced to approximately 628 million gallons annually, as a result of the elimination of several outfalls, downspout disconnections, some sewer separation projects, and infiltration of stormwater to sumps in some areas served by combined sewers. In 2006, the West Side CSO Tunnel Project was completed and the annual CSO volume was reduced to approximately 195 million gallons. Upon completion of the East Side CSO Tunnel Project in 2011, the annual estimated CSO volume in the Portland Harbor area will be approximately 20 million gallons.

Contaminants in CSO discharges identified in a 1997 DEQ report for sampling are bacteria,[24] copper, and lead (DEQ 1997). A review of Annual Pretreatment Reports to DEQ was conducted to determine other potential COIs. Table 4.4-~~5~~7 shows only those industries that currently discharge pretreated industrial wastewater to a portion of the combined sewer system that can overflow in the Portland Harbor Study Area. All of these permittees discharge to a CSO located at or upstream of RM 9.8, and most are located on the west side of the river, where industrial areas were not separated when the interceptors were installed.

~~There~~Although there are 21 permitted industries ~~that~~, 11 permittees do not discharge to the City's conveyance system. Fifteen industries were required to have permits based on the potential to exceed local limits, and their industrial activities are related to food and beverages, laundries, rubber processing, bag manufacturing, photographic processing, press and printing, and transportation. COIs[25] based on the permit discharge limits for these 15 industries include metals, oil and grease, and volatile organics. Four permits are for discharge of groundwater (either from remediation sites or construction dewatering) to the combined system, and COIs are identified as oil and grease, BTEX, and metals. Three permitted discharges are for metals-related industries, and COIs are identified as metals, oil and grease, cyanide, and total toxic organics. Industrial dischargers are required to list all potential pollutants in their permits even if they do not pretreat and discharge those constituents. The City prohibits discharge of many toxic wastes to its combined and sanitary system, including PCBs and pesticides.[26]

A CSO is composed of approximately 80 percent stormwater and 20 percent sanitary and pretreated industrial wastewater and, therefore, CSO water quality can also be affected by the exposure to stormwater and contaminants in domestic sewage (see Section 4.3.1.3~~.~~). Table 4.4-~~1~~3 (see italicized sites) shows the identified potential stormwater sources in the CSO basins and associated COIs.

4.4.2 Overland Transport

Overland transport has been identified as a complete and current pathway at two facilities: Gunderson and Triangle Park. This pathway is likely complete at Gasco. The other sites or portions of these sites lack stormwater conveyance systems, and

[24] Bacteria is not a risk-based COI in Portland Harbor.
[25] BOD and pH listed in permits are not included as COIs because they are not risk-based COIs in Portland Harbor.
[26] Portland City Code Chapter 17.34; Industrial Wastewater Discharges Administrative Rules ENB-4.03. These are current discharge prohibitions. General discharge prohibitions have been in City Code since the 1960s and the City Charter since as early as 1942.

stormwater either infiltrates the ground or discharges to the river via sheet runoff. This pathway is rarely investigated and could occur at other sites in the Study Area.

4.4.3 Groundwater

Based on the conceptual understanding of the regional hydrogeology (see Section~~-~~ 3.1.3), groundwater discharge to the river is expected to occur over most of the Study Area. However, this does not mean that all upland areas represent sources of contamination to the river via the groundwater pathway. Understanding the groundwater pathway as a source of contamination to the river requires an understanding of the distribution of upland plumes in relation to the river and the hydrogeologic factors affecting the migration and discharge of groundwater and groundwater contaminants to the river.

4.4.3.1 Assessment of the Groundwater Pathway during the Remedial Investigation

In cooperation with the USEPA and DEQ, the LWG initiated the ~~groundwater pathway assessment (~~GWPA~~)~~ for the Study Area in 2003. The scope of the ~~B~~GWPA was to identify facilities where existing information indicated there was contaminated groundwater that likely was discharging to the river and selecting locations adjacent to the facilities where transition zone samples would be taken to see whether known groundwater contamination could be detected in the river. The GWPA was not scoped nor implemented in a fashion to fully characterize every plume discharging to the river or to investigate every potential source of groundwater discharging to the river. The GWPA consisted of detailed file reviews on upland contaminated groundwater at ECSI sites and consultation with DEQ site managers; selection of a subset of high-priority sites for inclusion in GWPA field investigations; agreement by USEPA to those sites for transition zone confirmatory investigation; performance of these field investigations; and detailed, site-specific evaluation of the results of these investigations, using multiple lines of evidence to reach conclusions with respect to the existence of complete groundwater transport pathways to the lower Willamette River and their potential significance as a source of contamination to TZW and sediment in the lower Willamette River. The primary findings of the GWPA are summarized below. Detailed documentation of the GWPA is provided in Appendix C2. Complete and updated information about facilities with current groundwater contamination is discussed in DEQ's September 2010 Milestone Report (see Appendix B) and January 2013 Milestone Report available online at http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/jointsource.htm.

Nine sites were included in the Round 2 GWPA field investigations because they met certain established criteria, such as~~:~~ the upland source of COIs is present, COIs have been detected in upland groundwater, and a groundwater pathway from the upland site to the river is complete or is reasonably likely to be complete. This last criterion is met when COIs present in upland groundwater are either confirmed or, based on professional ju~~s~~dgement, believed to have a reasonable potential to discharge to the river (via sediment, the transition zone, surface water, or a combination thereof). A summary of the evaluation of each site against the inclusion criteria is presented in Table C2.3-1 of Appendix C2, and complete summaries for the nine selected GWPA sites, including general background, hydrogeology, and the nature and extent of COIs in groundwater, are presented in Appendices A-1 through A-9 of the GWPA SAP (Integral, Kennedy/Jenks, and Windward 2005).

4.4.3.1.1 Distribution of Upland Groundwater COIs at GWPA Study Sites

For each of the nine sites included in the GWPA field investigations, a series of figures has been prepared displaying the distribution of NAPL (if present) and COIs in upland groundwater, based on available upland data ~~presented in Table X.~~. These sites and associated COIs are listed below:

~~Site Name~~	~~Selected COIs~~	~~Figure Numbers~~
~~Kinder Morgan Linnton~~	~~NAPL, total BTEX, total PAHs, arsenic~~	~~4.4-2a–d~~
~~ARCO~~	~~NAPL, total BTEX, total PAHs, lead, arsenic~~	~~4.4-3a–e~~
~~ExxonMobil~~	~~NAPL, total BTEX, arsenic, lead, zinc~~	~~4.4-4a–e~~
~~Gasco~~	~~NAPL, total BTEX, naphthalene, total cyanide~~	~~4.4-5a–d~~
~~Siltronic~~	~~NAPL, total BTEX, trichloroethene, cis-1,2-dichloroethene, vinyl chloride~~	~~4.4-6a–e~~
~~Rhone Poulenc~~	~~NAPL, 1,2-dichlorobenzene, trichloroethene, Silvex, arsenic~~	~~4.4-7a–e~~
~~Arkema~~	~~NAPL, chlorobenzene, perchlorate, total of 4,4'-DDx, chromium~~	~~4.4-8a–f~~
~~Willbridge Terminal~~	~~NAPL, total BTEX, total PAHs, total chromium~~	~~4.4-9a–d~~
~~Gunderson~~	~~1,1,1,-Trichloroethane, 1,1-dichloroethene, total lead~~	~~4.4-10a–c~~

- Kinder Morgan Linnton—NAPL, total BTEX, total PAHs, arsenic (Figures 4.4-2a–d)
- ARCO— NAPL, total BTEX, total PAHs, lead, arsenic (Figures 4.4-3a–e)
- ExxonMobil— NAPL, total BTEX, arsenic, lead, zinc (Figures 4.4-4a–e)
- Gasco— NAPL, total BTEX, naphthalene, total cyanide (Figures 4.4-5a–d)
- Siltronic—NAPL, total BTEX, trichloroethene, *cis*-1,2-dichloroethene, vinyl chloride (Figures 4.4-6a–e)
- Rhone Poulenc— NAPL, 1,2-dichlorobenzene, trichloroethene, Silvex, arsenic (Figures 4.4-7a–e)

Commented [A12]: EPA: Need table number and move table to section with associated tables for this section.

Integral: Made into bulleted list.

- Arkema— NAPL, chlorobenzene, perchlorate, total of 4,4'-DDx, chromium (Figures 4.4-8a–f)
- Willbridge Terminal— NAPL, total BTEX, total PAHs, total chromium (Figures 4.4-9a–d)
- Gunderson—1,1,1,-trichloroethane, 1,1-dichloroethene, total lead (Figures 4.4-10a–c).

The COIs presented in these figures are not intended to be inclusive of all contaminants detected in upland groundwater at the site; rather those presented represent the occurrence, distribution, and concentrations of select COIs for a given site.

4.4.3.1.2 Summary of Major Findings of the GWPA

Based on consideration of the multiple lines of evidence discussed above and presented in detail in Appendix C2, the GWPA reached the following overall conclusions with respect to the potential role of the groundwater transport pathway as potential source of contamination to sediments and TZW in the ~~LWR~~lower Willamette River for the nine GWPA study sites:

- **Kinder Morgan Linnton Terminal (GATX).** The combined lines of evidence suggest some possibility that low levels of PAHs in upland groundwater may be migrating to the transition zone in the groundwater discharge zone offshore of the Kinder Morgan Linnton site. For other upland groundwater COIs at this site, however, there is no evidence of a complete and significant transport pathway to the TZW environment. (See Section C3.1.5 of Appendix C2.)
- **ARCO.** Migration of chemicals in upland groundwater to the transition zone is likely complete. (See Section C3.2.5 of Appendix C2.)
- **ExxonMobil Oil Terminal.** The findings of the Round 2 GWPA suggest that BTEX and metals in upland groundwater at the ExxonMobil site may have been transported to the TZW via groundwater flow. In ~~date?~~2005, an upland groundwater source control measure was implemented. It is also plausible that the chemicals detected in TZW samples collected at this site during the RI reflect chemical partitioning from sediment to pore water rather than transport from upland groundwater. (See Section C3.3.5 of Appendix C2.)
- **Gasco.** The findings of the Round 2 GWPA and NW Natural's in-water investigation at the Gasco site indicate a complete groundwater pathway for VOCs and PAHs to the transition zone. (See Section C3.4.5 of Appendix C2.)
- **Siltronic.** The pathways for chlorinated ~~volatile organic compounds~~VOCs in the offshore zone and PAHs, BTEX, and TPH in the nearshore zone are complete. (See Section C3.5.5 of Appendix C2.)
- **Rhone Poulenc.** A complete pathway for transport of two upland groundwater COIs (1,2-dichlorobenzene and Silvex) to the transition zone is present. (See

Commented [A13]: EPA: Insert date source control measure was implemented.

Integral: Done

Section C3.6.5 of Appendix C2, as well as the November 19, 2010 RI/SCE Report for the Rhone Poulenc Portland Site; AMEC 2010b.)

- **Arkema.** The pathway for transport of chlorobenzene, perchlorate, DDx, and chromium from the upland groundwater ~~COIs~~ to the transition zone within the nearshore and intermediate zones is complete. (See Section C3.7.5 of Appendix C2.)
- **Willbridge Terminal.** Based on concentrations and spatial patterns in TZW, a complete groundwater transport pathway from the upland to the transition zone does not appear to be present. (See Section C3.8.5 of Appendix C2.)
- **Gunderson.** Chlorinated solvents measured in nearshore TZW off Area 1 was a complete pathway. In ~~date?~~2006, remediation system extraction wells were installed. (See Section C3.9.5 of Appendix C2.)

Commented [A14]: EPA: Insert date when wells were installed.

Integral: Done

4.4.3.2 Study Area-Wide Summary of the Groundwater Transport Pathway

Table 4.2-2 presents the Study Area-wide understanding of the current groundwater transport pathway at DEQ ECSI sites based on late 2010 information from DEQ on the status of the sites and pathways. Maps 4.4-3a–h provide a river-mile-scale view of groundwater areas identified by DEQ to be affected by upland COIs in the vicinity of the Portland Harbor and the identified zones of in-river groundwater plume discharge, both interpreted and potential.

The groundwater pathway has been reasonably well-characterized at about half of the sites listed in Table 4.2-2, as summarized by category below:

- Documented evidence of a complete current pathway (a): 12 sites
- Likely a complete current pathway (b): 1 site
- Insufficient data to make determination (c): 80 sites[27]
- Not a complete current pathway (d): 27 sites.[28]

In addition, groundwater discharging to stormwater pipes has been identified at 11 facilities. DEQ's evaluation of pathways, which has been reproduced in Appendix B, reaches similar conclusions with respect to the groundwater evaluation of the current status of the sites, with a few areas of potential disagreement:

- DEQ determined that the groundwater pathway was "insignificant" at several sites based on "screening" in an earlier version of the Milestone Report (i.e., July 2006); however, in Table 4.2-2, sites without groundwater investigations are classified as category c (insufficient data to make determination). These sites identified by DEQ include Alder Creek, Babcock Land Company, Chase

[27] Reflects EOSM's C-c pathway for metals only, see Table 4.2-2.
[28] Reflects EOSM's C-d pathway for TPH only, see Table 4.2-2.

Bag, Ryerson & Son, McWhorter Technologies, Olympic Pipeline, RK Storage, Schnitzer – Doane Lake, and Transloader International. LWG identifies all sites with no groundwater data as having insufficient data to make a determination. Sites for which insufficient data were available to determine if any of the GWPA inclusion criteria are met were referred to ~~the~~ Oregon DEQ for additional upland groundwater characterization.

- Conclusions about complete pathways reached in the GWPA differ from the late 2010 designations. Specifically, the GWPA did not confirm that complete and/or significant (in terms of influence on TZW and sediment chemistry) groundwater transport pathways exist at ARCO, ExxonMobil, Kinder Morgan, Willbridge Terminal, Premier Edible Oils, ST Services, Port of Portland Terminal 4, Slip 3, and Triangle Park, whereas the Milestone Report identifies complete pathways for these sites. ~~The~~ DEQ reduced the status of the groundwater pathway at ARCO and Willbridge Terminal from known (a) to likely (b).

4.4.4 Riverbank Erosion

Currently about 75 percent of the riverbanks within the Study Area are stabilized and armored with various engineered materials, including seawalls, riprap, structures, and engineered soil (Map 3.1-17). Riverbank erosion from unstabilized bank areas may represent an ongoing release mechanism in the Study Area. Riverbank erosion is identified on Table 4.2-2 as a "known" current pathway at six ECSI sites: Arkema, Gasco, EOSM, Gunderson, Triangle Park, and Terminal 4 (Slip 3).[29] This identification is based upon the detection of elevated concentrations of COIs in riverbank soils. Many other ECSI sites have not been evaluated as to the completeness of this pathway and if a bank has not been armored (e.g., sea walls and rip-rap) and there have been significant releases, it should be assumed that this pathway has the potential to release contamination to the Willamette River.

Today, riverbank stabilization and remediation plans are underway at several of these facilities.

4.4.5 Atmospheric Deposition

Similar to historical sources, current regional sources include automotive emissions, pesticide applications, and energy generation. Chemicals commonly acknowledged to play an atmospheric source role in urban river settings within the broader geographic region of the Pacific Northwest include PCBs, dioxins/furans, PAHs, and mercury (see Section 4.3.5). Air pollution (e.g., vehicle and industrial emissions, other combustion products, fugitive dust, etc.) can enter the river directly through the processes of dry and wet deposition. Agricultural air pollution comes from contemporary practices which include clear felling and burning of natural vegetation as well as spraying of pesticides

[29] See also Map 4.~~6-1a~~4-4a.

and herbicides. Atmospheric deposition is known to be a source of contamination globally, and its relative importance in the Study Area in terms of atmospheric loading to the Study Area is evaluated in Section 6 of this report.

4.4.6 Overwater Releases

Given the industrial and marine uses within the Study Area, overwater spills are likely to occur directly into the river either intentionally or unintentionally. As discussed in Section 4.~~2~~3.6~~.2~~, current overwater spills are those that have occurred since January 1, 2004. As shown in Table 4.~~2-~~3-5, documented spills have occurred since January 1, 2004 at approximately 22 facilities located within the Study Area. The nature of reported spills ranges widely, from dropped bottles to sheens of unknown origin to a 100-gallon spill of lubricating oil in April 2007, as a result of equipment failure at the Cascade General facility. Not all spills are reported or reflected in Table 4.~~2-~~3-5.

The activities most commonly associated with spills in the Study Area are product handling, overwater activities such as refueling, and vessel leaks:

- **Product handling**. Many facilities are now required to maintain spill prevention plans and have instituted practices to reduce spills.
- **Overwater activities.** Overwater activities, including ship repair or vessel refueling, are potential sources to surface water and sediment contamination. Regulations and BMPs have reduced such contributions in recent years. Spills during refueling are the most common type of overwater spill, but incidents during transfer of other materials (e.g., paint, hydraulic fluid, coal tar pitch) have also been reported. Furthermore, the operation of boat motors may contribute to surface water and sediment contamination.
- **Vessel leaks.** On average, 20 spills from vessels directly into the ~~LWR~~lower Willamette River are reported to the USCG each year (NRC 2010), nearly all of which are diesel fuel, gasoline, hydraulic oil, lubricating oil, or waste oil. Bilge and ballast water from vessels has also been released. A detailed list of vessel spills is included in Table 4.3-~~4~~6. In addition to the types of releases above, the spills include sandblast grit, sewage, paint mixtures, sulfuric acid, and grain in volumes ranging from unknown sheen quantities to barrels. Reasons for spills vary, but are primarily related to equipment or operator error.

Utility crossings are a potential source of spills in the Study Area. One petroleum pipeline crosses the Willamette River within the Study Area. It is located between the Willbridge bulk fuel terminal and south end of Triangle Park (approximately RM 7.7). Gasoline lines cross the river at RM 2.8 and near the Sauvie Island Bridge in the Multnomah Channel. Two sewer lines cross the river, one at RM 7 and the other near RM 10. There are no records of spills or leaks from these crossings.

4.4.7 Source Control Measures

Under the 2001 MOU, DEQ is the lead agency responsible for identifying and controlling upland sources of contamination. USEPA is the lead agency for overseeing the investigation and cleanup of the in-water portion of the Study Area. Together, these two agencies developed the Portland Harbor JSCS in 2004 with the goals of identifying, evaluating, and controlling sources of contamination that may affect the lower Willamette River.

Upland source control is necessary to allow cleanup of the river to proceed without the risk of recontamination. Source control measures are implemented at a given site to address ongoing sources of contamination ~~e~~. Currently, DEQ is investigating or directing source control work at over 80 upland sites in Portland Harbor.

For DEQ, upland source control is an iterative process, where conclusions determined earlier may be refined by information gathered later in the process. The 2010 Milestone Report lists the following combination of tools that DEQ uses to control a source(s):

- Technical assistance.
- Cleaning up contaminated upland areas by removing highly contaminated soil areas, stabilizing or capping contaminated bank areas, treating or containing contaminated groundwater, and extracting contaminated sediment from storm sewer systems.
- Source control of active discharges using BMPs, industrial process changes, pollution prevention practices, and technology-based effluent controls. Compliance is achieved voluntarily or through administrative actions, including permits or enforcement.
- Source control of stormwater.
- Administrative actions and enforcement, such as licenses, permits, deed restrictions, requirements for site development plans, and enforcement actions, which may be necessary when administrative actions are violated.

Table 1 of the 2010 Milestone Report (reproduced as Appendix B) summarizes, for a given site, the status and type of source control activities, the basis for determining if source control is needed, and the schedule for implementing source control measures. Sites listed in the table are only those sites for which DEQ is actively overseeing upland investigations or source control activities (also including sites for which source control decisions have been made). Several ECSI sites are not included in the table because DEQ does not believe these sites are contributors to Willamette River contamination, because there is insufficient information to determine if the site is a contributor but the site has not entered DEQ's cleanup program, or because DEQ had not amended the Milestone Report to align with the expanded Study Area (e.g., ECSI sites in the RM 11 to 11.8 reach). The January 2013 Milestone Report is available online at http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/jointsource.htm.

Information from Table 1 of the 2010 Report has been graphically displayed in Maps- 4.~~6-1a~~4-4a–e for each of the major pathways of a particular site: riverbank erosion, groundwater, overland transport, overwater activities, and stormwater/wastewater. Sites on the maps are shaded different colors to correspond with the status of the following DEQ source control activities:

- Red – Source control evaluation is ongoing
- Blue – Source control evaluation has not started yet
- Green – The source control evaluation is complete or under DEQ/USEPA review
- Yellow – A "No Further Action" determination has been made for the site
- Gray – The pathway does not exist for a site
- White – Site is not included in Table 1 of the Milestone Report.

For each ECSI site on Maps 4.~~6-1a~~4-4a–e, a symbol is included that corresponds with DEQ's interpretation of the potential for that pathway to impact in-water media. The priority levels for sites and pathways, as described in the footnotes to DEQ's Table 1, are provided below:

> **High** = High priority pathways and sites are those where a complete migration pathway exists and the upland source is significantly impacting the river or poses a significant and imminent threat to the river based on initial evaluation of key source control prioritization factors (see p. 4-3 of the JSCS). A primary consideration is that one or more media (soil, water, air) significantly exceed applicable Screening Level Values (SLVs) at the point of discharge to the river (e.g., water at the end of a discharge pipe, or soil or material at the riverbank) or the most reliable and cost-effective data point (e.g., groundwater measured at the shoreline), or where a bioaccumulative chemical is detected at concentrations significantly above the SLV. In addition, if an upland source is violating DEQ narrative water quality criteria for the Willamette River, the site may be considered a high priority. High priority sites are expected to move forward with aggressive source control measures without delay or be subject to enforcement action.
>
> **Medium** = Medium priority pathways and sites are those where a complete contaminant migration pathway exists and the upland source is impacting the river or poses a significant and/or imminent threat to the river based on an initial evaluation of key source control prioritization factors (see p. 4-3 JSCS). A primary consideration is that one or more media exceed applicable SLVs, but not significantly, at the point of discharge to the river, or where a bioaccumulative chemical is detected at concentrations above the SLV. Although exceedance of SLVs does not necessarily indicate a site poses a significant and/or imminent threat or needs to immediately implement source control measures, it does indicate that the site may pose a threat to human health or the environment and that additional evaluation may be needed to determine if source control measures are required to prevent, minimize or mitigate the migration of hazardous substances to the river. If the site exceeds one or more SLVs, the need for further characterization or for implementation of source control measures will be based on a site-specific weight-of-evidence determination. Medium priority

> sites are expected to perform a weight-of-evidence evaluation to determine if source control measures are required.
>
> **Low** = Low priority pathways and sites are those where upland data indicate, based on an initial evaluation of key source control prioritization factors (listed on p. 4-3 JSCS), that the site likely poses a low threat to the river (e.g., concentrations are near or below SLVs) or where DEQ, in consultation with EPA, may issue an upland "No Further Action" (NFA) determination or lower the State's priority of the site for further upland investigation or remedial action under DEQ's cleanup authority. Source control measures will not be required at low priority sites unless determined necessary by the results of the Portland Harbor RIFS or ROD.

As of September 2010, the ECSI sites were categorized, according to DEQ's source control efforts, into the following categories:

- High-priority sites~~—~~—11
- Preliminary high-priority sites~~—~~—5
- Medium-priority sites~~—~~—24
- Low-priority sites~~—~~—23
- Priority to be determined~~—~~—3
- Sites with source control decisions~~—~~—24.

Additionally, DEQ and the City (under an Intergovernmental Agreement) are jointly working together to identify and control upland sources draining to the Study Area through City outfalls.

4.5 HISTORICAL AND CURRENT SOURCES OUTSIDE THE STUDY AREA

Point and nonpoint discharges within the Willamette River Basin are potential sources of contamination in sediment, surface water, and biota in the Study Area. Chemicals in discharges and runoff from diverse land uses in the basin eventually make their way to the river by the time it flows into the Study Area. Contaminant loading from sediment transport and water from upstream areas throughout the last century also contributed to the conditions currently observed in the Study Area.

4.5.1 Non-Study-Area Sources in the Lower Willamette River

Sources in the ~~LWR~~lower Willamette River, both downstream and upstream of the Study Area, may contribute to chemical deposition within the Study Area. The Study Area is at the downstream end of a large basin with a long history of industrial, municipal, and agricultural inputs. Significant agricultural runoff persists upriver, and together with inputs from other industries and cities upstream, as well as atmospheric deposition in the watershed, the river's chemical burden is already elevated before entering the Study Area.

These upstream and downstream areas are prone to flooding, as evidenced during the major flood events of the past century. Flooding contributes to in-water contamination by eroding contaminated riverbank areas and other surface soils, and potentially breaching historical wastewater containment ponds proximal to the river. Today, many riverbanks have been armored with seawalls, riprap, and other engineered materials. The 32-ft-tall seawall that extends approximately one mile from the Hawthorne Bridge to the Steel Bridge was constructed by the City from 1923 to 1929 as a bulwark against floods (Blalock 2008).

Shoreline facilities upstream of the Study Area that are included in DEQ's ECSI database are listed in Table 4.~~5-1~~2-3, with locations shown in Maps 4.~~5-1a-~~2-2a–d. Note that unless a pathway was identified as a complete pathway to the river in the ECSI database, the LWG has not independently confirmed that sites listed on Table 4.~~5-1~~2-3 and Maps 4.~~5-1a-~~2-2a–d have had a confirmed pathway to the river.

The downtown reach is immediately south (upstream) of the Study Area. It is described as (GSI 2009b):

> The downtown reach of the Willamette River has been used and modified for more than 150 years. Various industrial activities have occurred on the banks of the river, including ship building and ship breaking, heavy manufacturing, pesticide formulating, manufactured gas production, power generation and distribution, lumber processing, and commodities importing and exporting. The river banks have been significantly modified and used for automotive transportation, particularly in the lower half of the downtown reach. Waterfront and upland facilities and roadways may have contributed contaminants to the Willamette River via direct discharges (e.g., stormwater and non-stormwater flows), groundwater discharges, overwater activities, overland runoff, or bank erosion.

The downtown reach has been the focus of a collaborative effort by DEQ, the City of Portland, ZRZ Realty Company, Portland General Electric, and TriMet to evaluate the potential presence of contaminants in sediment from RM 12 to 16, immediately upstream from the RI Study Area. The focus of this effort is to determine where source control measures or cleanup activities should be implemented at riverfront properties (as well as facilities discharging to shared conveyances) to minimize potential contamination (GSI 2009b). ~~Results of these investigations are discussed in Appendix H.~~

One of these sites, the former Portland MGP facility at RM 12.2W has been the focus of an upland and in-water source control investigation under a Consent Order with DEQ executed in April 2009. This facility operated between 1860 and 1913 for manufacturing gas from coal, carbureted water (water enriched with oil), and, briefly, oil. Initial review of sediment results shows that MGP-related contaminants including PAHs, VOCs, and cyanide are present in the Willamette River adjacent to the former gas manufacturing site, most notably in subsurface sediments adjacent to Block 5 of the former site. Limited impacts were observed in shallow upland wells (to 56 ft bgs) installed along the riverfront to assess the potential for ongoing impacts to the river from historical upland releases. Phase 2 follow-up investigations found elevated VOCs and PAHs in deeper upland groundwater zones (to approximately 130 ft bgs), in particular in the 65 to75-ft bgs zone, which appears to coincide with the fill/native sediment interface. The latest proposal is to install deeper wells at four riverside locations corresponding to the former Block 5 of the MGP operation, and adjoining locations to the north and south.

Another site, the former 17-acre Zidell property (owned by the ZRZ Realty Co.) is located on the west bank of the Willamette at RM 14. The Zidell site was used for ship building, ship dismantling, welding, and other ship activities from 1916 until the 1960s. Barge building activities are currently ongoing. As a result of these activities, the onsite soils and offshore sediment are contaminated with asbestos, metals, petroleum hydrocarbons, PAHs, butyltins, and PCBs above state-mandated cleanup levels. According to ~~USACE (2010b),~~DEQ (2013) this property is the focus of a major cleanup effort involving the removal or capping of 17,000 yd^3 of contaminated soils and sediment, updates to the stormwater management system, removal of invasive species, removal of treated wood pilings and a floating dock, and bank stabilization. Cleanup activities began in the summer of 2011 (~~USACE 2010b~~DEQ 2013).

Commented [A15]: EPA:
It is very odd to cite the USACE as a source describing a DEQ cleanup. The DEQ cleanup plan should be the reference. Need to update.

Integral: New reference inserted

Commented [A16]: EPA:
Same comment.

Integral: New reference inserted

At the PGE Station L site (RM 13.1 to 13.5E), PCB oils were generally used in electrical equipment from the mid-1930s to the 1970s. Soils, various structures onsite, and Willamette River sediments were found to be contaminated with PCBs that were released from transformers. Dredging and capping of river sediments was conducted from 1990–1991. The multi-layer cap was constructed with sand, gravel, and riprap to a thickness of greater than 6 ft. A Record of Decision for No Further Action at the site was issued by DEQ in 1994 (DEQ 2011b). As a result of DEQ's 2009 downtown reach sediment evaluation, PGE is currently evaluating sediment and upland sources between RM 13.1 and 13.5 to determine if additional sediment remediation or source control is needed adjacent to the historical PGE Station L and Station F/Inman-Poulson Lumber mill site.

Maps 4.~~5-1a~~2-2a–d also show outfalls upstream of the Study Area. Outfalls in the downtown reach have not been fully mapped, and this is an ongoing effort by the City. These maps show outfalls that were identified by the City as of February 2010. These include municipal outfalls, including CSO outfalls, and other public and private outfalls. Table 4.5-~~2~~1 lists currently available data on NPDES-permitted discharges from facilities upstream (to Willamette Falls) and downstream of the Study Area (Anderson 2006a,b, pers. comm.).

The list of impaired waters in Oregon prepared under Section 303(d) of the federal CWA and its amendments includes the main stem and tributaries of the Willamette River. In 2008, the 303(d) listings in the lower Willamette River (RM 0 to 24.8 as defined by DEQ)[30] included aldrin, DDT, DDE, dieldrin, iron, manganese, mercury,

[30] For most recent listing see: http://www.deq.state.or.us/wq/assessment/rpt0406/results.asp

PCBs, PCP, PAHs, temperature, and bacteria. Johnson Creek, a tributary that enters at RM 18, is listed for toxic chemicals, including dieldrin, DDT, PAHs, and PCBs. DEQ has developed total maximum daily loads (TMDLs) for temperature, bacteria, dieldrin, and DDT in Johnson Creek to reduce these watershed contaminants.

4.5.2 Sources above Willamette Falls (Upper Willamette River)

Both point sources and nonpoint sources of contamination are present above Willamette Falls. The extent to which agriculture, forestry, urban land use, geologic features, and atmospheric deposition may have contributed to conditions in Portland Harbor is unknown.

Table 4.5-~~3~~2 lists historical sources within the Willamette River basin above the falls that were present in 1967, according to OSSA. The table shows the source of waste (both industrial and municipal), the receiving stream, the Willamette river mile of the effluent discharge, the present treatment and disposal of wastes, and action needed by OSSA. Examples of the types of sources within the basin at that time included domestic sewage (with primary and/or secondary treatment), glue wastes from plywood manufacturers, pulp process wastewater, slaughterhouse wastes, kraft mill wastes, metal plating wastes, dye and wool fibers from woolen mills, sulfite mill wastes, and silage wastes.

Presently, more than 750 permitted discharges enter the Willamette River upstream of Willamette Falls, including 10 municipal sewage treatment plants and several pulp, paper, lumber, and fiberboard manufacturers. Hundreds of facilities also have general permits for discharge of noncontact cooling water and filter backwash, gravel mining waste streams, and tank cleaning fluids. Industrial stormwater discharge permits are held by facilities that handle paint, steel, metal plating, semiconductors, adhesives, and food products, as well as by landfills and transportation companies.

Most of the agricultural and forested land in the Willamette River Basin can generate nonpoint sources of pollution. The primary nonpoint source problem associated with forestry is accelerated sediment transport, but nutrients, fertilizers, and herbicides are also found in forest runoff. Erosion from agricultural lands in the Willamette Valley is the most commonly cited nonpoint source of pollutants in the upper reaches of the Willamette River Basin (Tetra Tech and E&S 1993), especially fertilizers, pesticides, and herbicides. In USGS studies of pesticides in the Willamette Basin (Wentz et al. 1998), the highest concentrations of organochlorine pesticides and PCBs were reported for three mostly agricultural sites. Historical mining is also an upriver source of mercury and lead. Historical discharges of dioxins from pulp and paper mills are relevant sources of contamination as well.

Nonpoint pollutants from the upper Willamette Basin (e.g., pesticides, PAHs, metals) also enter via runoff from residential, industrial, and commercial areas that do not require stormwater permits. Municipal stormwater permits are also held by cities in the upper Willamette Basin.

A fish advisory for mercury is in effect throughout the entire main stem of the Willamette River, due in part to runoff from natural volcanic sources, past mining activities, and atmospheric deposition in the upstream reaches of the Willamette River Basin.

DEQ's 303(d) list of impaired waters above Willamette Falls includes numerous tributaries of the Willamette River. The 303(d) listings in the main stem above Willamette Falls include aldrin, arsenic, DDT, DDE, dieldrin, iron, manganese, mercury, PCBs, DO, temperature, and bacteria. Most of the 303(d) listings for the upper Willamette River tributaries are for temperature and bacteria; other listings relate to nutrients, DO, turbidity, and pH. In addition, smaller creeks in the middle and upper Willamette sub-basins are listed for dieldrin, heptachlor, dichloroethylene, ~~PCE, TCE~~tetrachloroethene, trichloroethene, arsenic, copper, iron, lead, manganese, mercury, or zinc.

Based on the 303(d) list, DEQ has developed TMDLs for 11 of the 12 Willamette River sub-basins (Table 4.5-~~4~~3; DEQ 2006). TMDLs are currently being developed for the Yamhill sub-basin. Temperature, bacteria, and mercury TMDLs have been issued for all Willamette River sub-basins and the main stem. A PCDD/F TMDL was developed by USEPA in 1991 for the Willamette and Columbia rivers. Further reduction in watershed contaminants will likely occur as a result of TMDL implementation and other future watershed toxic reduction efforts.